

# **REPORT TO THE LEGISLATURE**

## **WISCONSIN GROUNDWATER COORDINATING COUNCIL**

**August 1995**

## GROUNDWATER COORDINATING COUNCIL MEMBERS

Department of Natural Resources - Susan L. Sylvester (Chair)  
Department of Agriculture, Trade, and Consumer Protection - Nick Neher  
Geological and Natural History Survey (State Geologist) - James Robertson  
Governor's Representative - John Metcalf  
Department of Health and Social Services - Dr. Henry Anderson  
Department of Industry, Labor, and Human Relations - Marvin Roshell/Bennette Burks  
Department of Transportation - Carol Cutshall  
University of Wisconsin System - Albert Beaver

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Department of Health and Social Services - Henry Anderson and Lynda Knobeloch  
Department of Industry, Labor and Human Relations - Bennette Burks/Harold Stanlick  
Department of Natural Resources - David Lindorff and Steve Karklins  
University of Wisconsin System - William Fetter and David Armstrong  
U. S. Geological Survey - Jim Krohelski

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Geological and Natural History Survey - Mike Bohn and Ron Hennings  
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Wisconsin Rural Water Association - Jon Cleveland

Council of Regional Planning Organizations - Chuck Kell and Bill Lane

Wisconsin Alliance of Cities - Bud Paruleski and Jim Trierweiler



101 South Webster Street  
Madison, Wisconsin 53707

August, 1995

To: The Citizens of Wisconsin

The Honorable Governor Tommy G. Thompson  
Senate Environment and Energy Committee  
Assembly Environment and Utilities Committee  
Assembly Natural Resources Committee  
Secretary Charles H. Thompson - Department of Transportation  
Secretary Carol N. Skornicka - Department of Industry, Labor and Human Relations  
Secretary Alan T. Tracy - Department of Agriculture, Trade and Consumer Protection  
Secretary Gerald Whitburn - Department of Health and Social Services  
Secretary George E. Meyer - Department of Natural Resources  
President Katharine Lyall - University of Wisconsin System  
State Geologist James Robertson - Geological and Natural History Survey

Susan L. Sylvester,  
Chair  
DNR

Carol Cutshall  
DOT

James Robertson  
WGNHS

Nicholas Neher  
DATCP

This is the 1995 Groundwater Coordinating Council (GCC) Report to the Legislature. The Council was formed in 1984 to help state agencies coordinate non-regulatory activities and exchange information on groundwater. The Council has served as a model for interagency coordination and cooperation among state government officials, the Governor, and local government. It has achieved the distinction of being one of the few groups in the nation to effectively coordinate groundwater activities in their state from an advisory position.

Henry Anderson  
DHSS

Bennette Burks  
DILHR

The groundwater accomplishments by your state agencies during the past year include:

Albert Beaver  
UWS

-Endorsement of Wisconsin's Comprehensive State Groundwater Program Plan (CSGWPP) as a core program plan by the U.S. EPA. Wisconsin is one of only four states to receive this endorsement. The GCC reviewed and approved the CSGWPP which was prepared by the DNR and reviewed by DATCP, DILHR, DHSS, DOT and the UWS. This endorsement once again sets Wisconsin ahead as a national leader. The EPA recognizes the importance of the GCC in coordinating cohesive groundwater management and regards the existence of the GCC as one of the strongest aspects of Wisconsin's groundwater program.

John Metcalf  
GOVERNOR'S REP.

-Submittal of the "Generic State Management Plan (SMP) for Protection of Groundwater from Pesticides" to the U.S. EPA for concurrence. The generic SMP was cooperatively drafted by DATCP and DNR over the past two years, and reviewed by DHSS and other interested agencies. The plan presents a comprehensive review of Wisconsin's efforts to prevent groundwater contamination due to pesticides.

-Preparation of 47 summaries of research/monitoring projects. Sixty-eight summaries from all agencies and the UW will be published together in early FY 96.

-Publication of the joint DNR-DHSS "Nitrate in Drinking Water" brochure, the DNR "Radon in Private Well Water" brochure and the DNR revised Groundwater Education Resource Directory.

We hope you, your staff, and the public will find this report a useful reference in protecting Wisconsin's valuable groundwater resource.

Sincerely,

Susan L. Sylvester, Chair  
Groundwater Coordinating Council

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## EXECUTIVE SUMMARY

This is the Report to the Legislature by the Groundwater Coordinating Council (GCC) as required by s. 15.347, Wisconsin Statutes. The report describes the condition and management of the groundwater resource and summarizes the Coordinating Council's activities for fiscal year (FY) 1995.

In 1984, the Legislature enacted Wisconsin Act 410 intending to improve the management of the state's groundwater. The GCC is directed by s. 160.50, Wis. Stats., to "serve as a means of increasing the efficiency and facilitating the effective functioning of state agencies in activities related to groundwater management. The Groundwater Coordinating Council shall advise and assist state agencies in the coordination of nonregulatory programs and the exchange of information related to groundwater, including, but not limited to, agency budgets for groundwater programs, groundwater monitoring, data management, public information and education, laboratory analysis and facilities, research activities and the appropriation and allocation of state funds for research."

Membership of the GCC includes the Secretaries of the Departments of Natural Resources (DNR); Industry, Labor and Human Relations (DLHR); Agriculture, Trade and Consumer Protection (DATCP); Health and Social Services (DHSS); Transportation (DOT); the President of the University of Wisconsin System (UWS); the State Geologist; and a representative of the Governor. Members are listed on the inside of the front cover.

Since its last report, the Groundwater Coordinating Council has accomplished the following:

1. The GCC and the UWS Groundwater Research Advisory Council continued coordination of the annual solicitation for groundwater research and monitoring proposals among state agencies. Thirty-four projects were funded in FY 95 by one or more of the following agencies: UWS, DATCP, DNR and DLHR. The projects funded are listed in Table 1. The locations of the field sites for the projects are shown in Figure 2. A joint solicitation for groundwater-related monitoring and research project proposals for funding in FY 96 was distributed in November, 1994. A copy of the joint solicitation is contained in the Appendix to this report. A total of 40 project proposals were received. Eighteen new projects were selected by the UWS, DNR, DLHR, and/or DATCP for funding in FY 96 in addition to 13 projects which will carry over into the new fiscal year. The FY 96 groundwater monitoring and research projects and their funding agency are listed in Table 2. The GCC endorsed the UWS groundwater research plan for FY 96 as required by s. 160.50(1m), Wis. Stats.
2. The GCC received endorsement from the U.S. EPA of Wisconsin's Comprehensive State Groundwater Program Plan (CSGWPP) as a core program plan. Wisconsin is one of only four states to receive this endorsement. The GCC reviewed and approved the CSGWPP which was prepared by the DNR and reviewed by DATCP, DLHR, DOT and representatives from the UWS before submittal to EPA. The CSGWPP consists of a state profile, a self-assessment and a vision statement. This endorsement once again sets Wisconsin ahead as a national leader. The EPA recognizes the importance of the GCC in coordinating cohesive groundwater management and regards the existence of the GCC as one of the strongest aspects of Wisconsin's groundwater program.
3. The GCC coordinated efforts to distribute the findings of groundwater monitoring and research funded through the joint solicitation process. DNR and UW Water Resources Center

(WRC) staff wrote summaries of 45 final reports in FY 95. Summaries of 65 reports will be published together in early FY 96. The DNR and WRC have nearly eliminated the backlog of final reports for which summaries have not been prepared. Copies of all final reports and summaries will be distributed by the WRC. DNR staff constructed a database for tracking research/monitoring project status. Plans were made to make the summaries accessible by computer through the National Library System and Wiselno online services.

- 4.The GCC provided guidance for the development of the "Generic State Management Plan for Protection of Groundwater from Pesticides". The generic SMP was cooperatively drafted by DATCP and DNR over the past two years, and reviewed by DHS and other interested agencies. The plan presents a comprehensive review of Wisconsin's regulatory and nonregulatory efforts to prevent groundwater contamination due to pesticides.
- 5.Prior to publication, the GCC reviewed and endorsed the joint DNR-DHS "Nitrate in Drinking Water" brochure and the GCC's revised Groundwater Education Resource Directory. The GCC also reviewed and endorsed the DNR Bureau of Water Supply's new "Radon in Drinking Water" brochure which will be published in early FY 96.
- 6.The GCC directed the preparation of a report on groundwater quantity. The DNR took the lead in establishing a technical advisory committee and gathering information. A draft report is being prepared which summarizes available information on groundwater quantity and provides options for managing problems (see also "Condition of the Resource: Groundwater Quantity"). The DNR added a groundwater quantity research priority to the 1996 joint solicitation package. Several related proposals were received, including four which were chosen for funding.
- 7.The GCC has continued to work with representatives of federal agencies to promote communication and coordination of federal and state groundwater activities. Representatives from the Natural Resource Conservation Service (NRCS), U. S. Agricultural Stabilization and Conservation Service (ASCS) and the U. S. Geological Survey (USGS) attend GCC meetings and serve as *ex officio* subcommittee members.
- 8.The GCC has continued to work with representatives of local units of government to address issues that affect local governments. The Local Government Subcommittee met and discussed implementation of wellhead protection on a county-wide basis.



# INTRODUCTION

## PURPOSE

The Groundwater Coordinating Council is required by s. 15.547, Wis. Stats., to prepare a report which "summarizes the operations and activities of the council ..., describes the state of the groundwater resource and its management and sets forth the recommendations of the council. The annual report shall include a description of the current groundwater quality of the state, an assessment of groundwater management programs, information on the implementation of ch. 160, Wis. Stats., and a list and description of current and anticipated groundwater problems." This report is due each August. The purpose of this report is to fulfill this requirement for FY 95.

The section, "Summary of Agency Activities" (p.7) describes groundwater management programs and implementation of ch. 160, Wis. Stats., by the individual state agencies. "Groundwater Monitoring and Research" provides information on monitoring and research activities to address groundwater issues in Wisconsin and describes the condition of the groundwater resource. The activities of the Groundwater Coordinating Council and its subcommittees are described under "Coordination Activities" and in the minutes which are contained in the appendix to this report. The recommendations of the Council are contained in "Directions for Future Groundwater Protection."

## SUMMARY OF WISCONSIN'S GROUNDWATER LEGISLATION

Wisconsin has a long history of groundwater protection. The culmination of this effort was adoption and implementation of 1983 Wisconsin Act 410, Wisconsin's Comprehensive Groundwater Protection Act which was signed into law on May 4, 1984. The law expanded Wisconsin's legal, organizational, and financial capacity for controlling groundwater pollution. The Groundwater Protection Act created chapter 160, Wisconsin Statutes, which serves as the backbone of Wisconsin's program. Chapter 160, Wis. Stats., provides a multi-agency comprehensive regulatory approach, using two-tiered numerical standards, based on the premise that all groundwater aquifers in Wisconsin are entitled to equal protection. There are a number of major components to Wisconsin's groundwater protection program:

- 1) Standards. Under chapter 160, Wis. Stats., the Department of Natural Resources (DNR) must establish state groundwater quality standards based on recommendations from the Department of Health and Social Services (DHSS). Standard setting is a continuing process based on a priority list of substances established by the DNR in conjunction with other state agencies. The state groundwater standards are contained in chapter NR 140, Wisconsin Administrative Code.
- 2) Regulatory Programs. Once groundwater quality standards are established, all state agencies must manage their regulatory programs to comply. Each state regulatory agency must promulgate rules to assure that the groundwater standards are met and to require appropriate responses when the standards are not met. The state regulatory agencies are the DNR (solid and hazardous waste, industrial and municipal wastewater, spills); the Department of Industry, Labor and Human Relations (DILHR) (private sewage systems, petroleum product storage tanks); the Department of Agriculture, Trade and Consumer Protection (DATCP) (pesticide use and storage and fertilizer storage); and the Department of Transportation (DOT) (salt storage). The implementation of the groundwater standards by the state agencies is described under "Summary of Agency Activities".

3) Aquifer Classification. One of the most important features of Wisconsin's groundwater law is an item that was omitted. When Wisconsin was debating the groundwater protection legislation, the U. S. Environmental Protection Agency (EPA) tried to develop a nationwide groundwater approach. A keystone of EPA's proposal was aquifer classification - a scheme whereby each aquifer would be classified according to its use, value or vulnerability and then would be protected to that classification level. This entails "writing off" certain aquifers as industrial aquifers not entitled to protection and never again usable for human water supply. Wisconsin said "no" to aquifer classification. The philosophical underpinning of Wisconsin's groundwater law is the belief that all groundwater in Wisconsin must be protected to assure that it can be used for people to drink.

4) Monitoring and Data Management. At the time the groundwater legislation was created, there was concern that Wisconsin needed a groundwater monitoring program to determine whether the groundwater standards were being met. Therefore, a groundwater monitoring program was created under s. 160.27, Wis. Stats. Money from the Groundwater Account of the Environmental Fund has been used for problem assessment monitoring, regulatory monitoring, at-risk monitoring and management practice monitoring, as well as establishment of a data management system for collection and management of the groundwater data. See the "Groundwater Monitoring and Research" discussion (p.29) in this report for further information.

5) Research. Although all state agencies must comply with the groundwater standards, the processes by which groundwater becomes contaminated, the technology for clean-up, the mechanisms to prevent contamination and the environmental and health effects of the contamination are often not well understood. In addition, the basic data on geology, soils, and groundwater hydrology is often not available. The UWS and the state agencies have recognized that additional efforts in these research areas are badly needed. The Governor and the Legislature included a new groundwater research appropriation for the UWS beginning with the 1989-1991 biennial budget. During the past year, the UWS and the Departments of Agriculture, Trade and Consumer Protection, Industry Labor and Human Relations, and Natural Resources participated in a joint solicitation for groundwater-related research and monitoring proposals for funding during fiscal year 1996. See the "Groundwater Monitoring and Research" discussion for more details.

6) Coordination. In establishing the groundwater law, the Legislature recognized that management of the state's groundwater resources was a responsibility divided among a number of state agencies. Therefore, the Groundwater Coordinating Council was created to advise and assist state agencies in the coordination of non-regulatory programs and the exchange of information related to groundwater. The Coordinating Council has been meeting since 1984. See the "Coordination Activities" discussion (p.71) in this report.

7) Local Groundwater Management. The Groundwater Protection Act clarified the powers and responsibilities of local governments to protect groundwater in partnership and consistent with state law.

a. Zoning authority for cities, villages, towns and counties was expanded to "encourage the protection of groundwater."

- b.Counties can adopt ordinances regulating disposal of septage on land (consistent with DNR requirements); cities, villages or towns may do so if the county does not.
- c.Counties can regulate (under DNR supervision) well construction and pump installation for certain private wells.
- d.Property assessors must consider the time and expense of repairing or replacing a contaminated well or water supply when assessing the market value of real property; they must consider the "environmental impairment" of the property value due to the presence of a solid or hazardous waste disposal facility.

The following report is intended to update the Legislature and Governor on the status of the state's groundwater program and the activities of the Groundwater Coordinating Council.

## SUMMARY OF AGENCY ACTIVITIES

The groundwater management efforts undertaken by the member agencies of the Groundwater Coordinating Council during the past year show that Wisconsin continues to have a strong commitment to protection of its groundwater resource.

### DEPARTMENT OF NATURAL RESOURCES

The Department of Natural Resources (DNR) has statutory authority as the central unit of state government to protect, maintain and improve groundwater within the state (s. 144.025(1), Wis. Stats.). The DNR establishes the groundwater quality standards for the state under authority of s. 144.025(2)(b) and ch. 160, Wis. Stats. In addition to the establishment of groundwater quality standards, DNR has specific regulatory programs.

DNR regulatory programs to protect groundwater fall into one of three categories: water supply, wastewater, and solid and hazardous waste management. In addition, the Groundwater Management Section (GMS) assists in coordinating groundwater activities of the DNR, as well as other state agencies. The GMS is responsible for adoption of groundwater standards contained in ch. NR 140, Wis. Adm. Code, development of an annual groundwater monitoring plan, coordination of the joint solicitation, review and management of groundwater monitoring projects, coordination of groundwater components of basin plans and of nonpoint source priority watershed projects, coordination of wellhead protection activities, and maintenance of a data management system for groundwater data.

In March 1995, the Natural Resources Board approved amendments to ch. NR 140, Wis. Adm. Code, which include groundwater standards for 13 additional substances and revise the standards for 10 others. The amendments were sent to the Legislature in April for review and were approved. The Legislature approved the amendments in May. The amendments were sent to the Revisor of Statutes in June and will become effective in September, 1995. Once the amendments become effective, ch. NR 140 will include groundwater standards for 109 substances of public health or welfare concern.

In August 1994, the DNR requested that the DHS review 24 additional substances for potential groundwater standards development. The DHS expects to transmit the draft recommendations to the DNR this fall. The DNR will then request public hearing authorization from the Natural Resources Board for the proposed groundwater standards and any other proposed amendments to ch. NR 140.

The NR 141 *Ad Hoc* External Advisory Committee met twice in FY 95 to discuss groundwater monitoring well requirements and has submitted recommendations to the DNR for review. The recommended changes to the code (NR 141, Wis. Adm. Code) include: flush mount manhole wall thickness of 1/4 inch, refined language, modified depths for the use of bentonite chips, and the inclusion of remediation wells in the code. Other recommendations by the advisory committee include developing tables for determining the amount of water to be purged during well development, educational efforts to enhance compliance with NR 141, and a strategy for labeling wells with a unique well number to allow tracking. Work has begun on methods for automating report submittals and developing a data base for tracking monitoring wells. The committee will continue to meet and discuss improvements to the code and ways to incorporate new technologies.

GMS staff performed 20 inspections of drilling operations in FY 95. These inspections are designed to educate drillers and consultants about NR 141 and to enhance compliance with the code. Training relating to NR 141 and drilling was given to district and central office staff to assist them in field inspections.

The DNR continued its groundwater monitoring program which includes problem assessment monitoring, at-risk well monitoring, management practice monitoring and regulatory monitoring. During FY 95, \$301,240 were awarded to 14 projects for the management practice monitoring program (see Table 1). The 14 projects were selected during the joint solicitation process described under "Groundwater Monitoring and Research" in this report.

During FY 96, approximately \$275,000 will be awarded to 12 projects for the management practice monitoring program (see Table 2). Five projects are new studies selected during this year's joint solicitation process.

The DNR is the lead state agency for developing and implementing the Wisconsin Wellhead Protection (WHP) Plan. The specific goal of Wisconsin's plan is to achieve localized groundwater pollution prevention measures in public water supply wellhead areas consistent with the state's overall goal for groundwater protection.

To achieve this goal the DNR, working with other state and federal agencies, and extensive citizen input, developed a two-part state WHP Program. The first part is mandatory. Wisconsin Administrative Code ch. NR 811 requires that a WHP protection plan be developed for any municipal water supply well developed since May 1, 1992. The plan must be submitted to the DNR Public Water Supply Section for approval. The second part of the WHP Plan is a voluntary program which covers any public water supply well approved prior to May 1, 1992.

The DNR has initiated a statewide public information campaign aimed at encouraging water purveyors to proactively protect their water supplies from potential sources of contamination. The Bureau of Water Resources Management has recently published a homeowners guide to groundwater practices and techniques which will help citizens minimize groundwater contamination, "Better Homes and Groundwater". The DNR is also committed to providing technical assistance to water suppliers who want to develop WHP plans for their water wells.

The DNR is actively promoting wellhead protection efforts in the state and continually working with the Wisconsin Rural Water Association to develop community plans and provide technical assistance through conferences and training sessions for community officials and water system operators. The DNR provides funding for a pilot project to develop a WHP plan will be completed for the entire county. The DNR has also entered into a contract with the Wisconsin Geological and Natural History Survey to develop a detailed water table map for Dane County and delineate advanced wellhead protection areas for all municipal water supply wells in the county.

In FY 95, GMS staff, with the help of a Groundwater Quantity Technical Advisory Committee, began preparing a report on the groundwater quantity issue (see "Condition of the Resource: Groundwater Quantity.") The GCC had identified the need for a report summarizing the status of the groundwater quantity issue for the Natural Resources Board. During FY 95, the Bureau of Water Supply continued several groundwater monitoring projects aimed at determining the impact of surface activities on groundwater and determining the extent of naturally occurring contaminants in drinking water wells. These included: 1) sampling for naturally occurring arsenic in the Lake Michigan, North Central and Southern Districts; 2) radon

sampling in private wells in the Lake Michigan District; 3) radon sampling of public community wells statewide; 4) sampling for volatile organic compounds (VOCs) at identified contamination sites in the Southeast District to determine the extent of groundwater contamination; and 5) continued VOC and pesticide sampling statewide at identified high risk sites. In addition, a project was initiated in Waukesha County to determine the extent of bacteriological and nitrate contamination in private wells in the county. More details on the DNR's monitoring activities are contained in the FY 95 Groundwater Quality Monitoring Plan.

During FY 95, Bureau of Water Resources Management staff increased efforts to address groundwater in the water quality management planning process. Water Quality Management (WQM) Plans are mandated by Section 208 of the Clean Water Act. The Plans provide water resources information along river basin and watershed boundaries.

The GMS liaison provides guidance on availability of, and direct access to, groundwater documents germane to the planning basin, as well as insight concerning ongoing research in the planning area. GMS staff obtain data from the Groundwater Retrieval Network to identify areas with nitrate and/or pesticide contamination for use in WQM Plan maps. By providing a GMS liaison to Water Quality Planners during development of WQM Plans, the accuracy and thoroughness of groundwater information in each WQM Plan will be enhanced. Groundwater information was provided for the Upper Rock, Wolf, and Lower Chippewa basins.

During FY 95, the Bureau also initiated a review of the groundwater criteria used to rank watersheds in WQM Plans for funding by the DNR Nonpoint Source Pollution Abatement Program. Although the review is ongoing, a key concern is to better address the link between groundwater and surface water interactions.

During FY 95, private wells in four existing watersheds and six new priority watersheds and one priority lake project were sampled for nitrate as part of the joint DNR-DATCP nonpoint source program. The existing priority watersheds are: South Fork Hay River, Branch River, Tomorrow/Waupaca River, and Lake Mendota Priority Lake. The new priority watersheds are the Duck Creek, Apple/Ashwaubenton Creeks, Dell Creek, Pensaukee River, Springbrook, and Osegoda Creek. The new priority lake project sampled was the Pine/Squaw/Bass/Perch Lakes Cluster. Sampling was offered to well owners free of charge and on a voluntary basis. All wells sampled were assigned a unique well number and inventoried. A total of 625 nitrate analyses were performed in FY 95 showing that nitrate + nitrite exceeded the preventive action limit (PAL) of 2 milligrams/liter (mg/l) in 55.8% and the enforcement standard (ES) of 10 mg/l in 18.7% of the samples analyzed. Additional funds were granted to the Whittlessey Creek Watersheds by the Bureau of Water Supply to sample private wells for bacteria and other parameters to complete groundwater quality appraisals for basin plans.

The Bureau of Solid and Hazardous Waste Management has undertaken 3 rulemaking activities recently. The Solid Waste Management Section continues to meet with an external technical advisory committee to consider revisions to administrative code chs. NR 500 through NR 522. The Hazardous Waste Management Section completed revisions to the ch. NR 600, Wis. Adm. Code, rule series (NR 600-685). These changes became effective on June 1, 1995. Included in the rule are changes to ch. NR 635, Wis. Adm. Code, which covers groundwater and leachate monitoring standards. Most revisions to ch. 635 are intended to mirror Federal requirements promulgated since the last comprehensive update to the hazardous waste code. However, a new section, s. NR 635.18, "Soils and Groundwater Investigations", has been created which upgrades the groundwater

monitoring standards for hazardous waste facilities to parallel the requirements for solid waste facilities found in chs. NR 500 through 522.

The Emergency and Remedial Response (ERR) section, with the help of an external advisory committee and a focus group completed a series of administrative codes (NR 700-736) covering remedial responses to environmental contamination including soil contamination. Two key elements of the rule went into effect in April and May of 1995. The two key elements are: (1) soil standards based on protection of groundwater, per ch. NR 140, Wis. Adm. Code, and direct contact to substances in soil; and (2) a standard remedy selection process. The latter is key to clearly defining how NR 140 groundwater standards will be used in remediating contaminated groundwater.

The ERR Section, with assistance from the GMS and Legal Services, has almost completed an NR 140 guidance document relating to groundwater clean-up. It is expected that it will be distributed in final form by fall 1995. The ERR Section and the Legislature are reviewing current reporting requirements for hazardous substance discharges (i.e. reporting all hazardous substance discharges immediately to the DNR). New reporting requirements, if recommended, will begin in 1996.

The ERR Section, as part of its responsibility to administer the State's Environmental Fund to cleanup severe contamination problems, initiated, or continued action at locations where groundwater contamination is known or suspected. Approximately \$4,000,000 was spent during FY 95 to address groundwater contamination at existing project sites. An additional \$4,000,000 was spent for upgrades at the Holtz/Krause landfill to prevent groundwater contamination.

The Municipal Wastewater Section (MWWSS) of the Bureau of Wastewater Management, continues to issue permits to communities utilizing land application for disposal of treated domestic wastewater. New municipal wastewater WPDSS permits reflect the more stringent effluent limits for total nitrogen and chloride contained in ch. NR 206, Wis. Adm. Code. Groundwater monitoring is required at municipal land application facilities to confirm compliance with NR 140 Groundwater Quality Standards. A concerted effort is being made to evaluate and require upgrading of groundwater monitoring systems at existing permitted facilities. The Section continues to work with unsewered communities, served by individual on-site treatment systems, in their efforts to construct centralized wastewater treatment facilities. As part of the DNR's responsibility to approve state on-site system rules, the MWWSS has worked with DILHR on its proposed on-site system regulations.

The Industrial Wastewater Section (IWWSS) continues to issue WPDSS permits to facilities which use land application of industrial waste waters, sludges, and/or food processing by-products, which may ultimately impact groundwater. Groundwater monitoring is required at all large land application and wastewater storage sites. Groundwater quality sample data are reviewed for compliance with ch. NR 140 as submitted. The IWWSS has nearly finished its evaluation of all industrial wastewater storage lagoons and large vegetable by-product storage structures. Per ch. NR 213, Wis. Adm. Code, approximately 200 facilities were required to conduct such evaluations and most were initiated in 1991-92. The majority of studies are now complete, resulting in the upgrading or abandonment of many lagoons. Facilities with lagoons adversely impacting the environment, including waters of the state, are required to meet the standards of ch. NR 213, Wis. Adm. Code, no later than July 1, 1995, or as specified by a WPDSS permit.

The Animal Waste Advisory Committee completed their report in January 1995. The recommendations contained in the report focused on appropriate management activities for livestock owners, to protect water quality. The committee's report was accepted by the Natural Resources Board in February 1995. DNR staff are working closely with interested legislators to draft legislation needed to implement the recommendations.

For more information, contact Mr. Mike Lemcke, DNR, P.O. Box 7921, Madison, WI 53707-7921; phone 608-266-2104.

## DEPARTMENT OF AGRICULTURE, TRADE AND CONSUMER PROTECTION

Protecting Wisconsin's groundwater is of the highest priority for the Department of Agriculture, Trade and Consumer Protection (DATCP). DATCP's major activities in this area include management of pesticides, research, and funding of local soil and water resource management projects.

Under the Wisconsin Groundwater Law, DATCP manages pesticides and pesticide practices to assure that established groundwater standards for contaminants are not exceeded. This may include prohibition of certain activities including pesticide use. The agency also manages practices to "minimize" groundwater contamination to the extent "technically and economically feasible". DATCP regulates storage, handling, use, and disposal of pesticides and the storage of bulk quantities of fertilizer.

DATCP is also responsible for coordinating the development of Wisconsin's "generic" and "pesticide-specific" state management plans (SMPs) for protecting groundwater from pesticides. In FY 95, DATCP, in cooperation with DNR and other agencies, drafted Wisconsin's "Generic State Management Plan for Protection of Groundwater from Pesticides", which was submitted to the EPA for concurrence. According to the EPA document, "Pesticides in Groundwater Strategy" (1991), when EPA determines that a pesticide presents a significant risk of leaching to groundwater in a state, it may either cancel the registration of that compound or allow the state to prepare an SMP describing how the state will manage the pesticide to protect groundwater. The generic SMP presents a comprehensive review of Wisconsin's regulatory and nonregulatory efforts to prevent groundwater contamination due to pesticides. This generic plan will serve as a framework for pesticide-specific SMPs that will be required by the EPA for five commonly used herbicides.

Enforcement standards have been established in Wisconsin for many known and potential groundwater contaminants, including over 30 pesticides. Standards for additional pesticides have been proposed. DATCP applies these standards and the Groundwater Law when addressing nonpoint and point sources of pesticide contamination in groundwater.

DATCP's primary effort related to nonpoint contamination (i.e., due to general use) of groundwater continues to involve the herbicide atrazine. In response to concerns about atrazine contamination, DATCP amended administrative rule ch. ATCP 30 in 1992 to manage the use of atrazine in an effort to reduce or eliminate the potential for further groundwater impacts. Rule revisions have been made annually in response to additional detections of atrazine in groundwater. Rule revisions for the 1995 growing season increased the number of atrazine use prohibition areas, based on groundwater sample results available as of September 1995.



Information suggests that atrazine use has declined as a result of the atrazine management rule and concern about groundwater contamination.

Since the late 1980s, DATCP has also initiated a number of surveys to investigate pesticides in groundwater resulting from nonpoint sources. In FY 95, DATCP completed a survey of alachlor and its ethane sulfonic acid (ESA) metabolite in Wisconsin groundwater. This study was funded by DATCP, DNR and Monsanto, and was designed to determine the extent of alachlor and ESA contamination in private wells most at risk in 11 southern Wisconsin counties. Of 669 wells with previous detections of atrazine or with nitrate levels above health standards, 1.8% had detectable levels of alachlor and 32% had detections of ESA.

In FY 95, DATCP also completed Phase 1 of a survey designed to evaluate the effectiveness of the Atrazine Rule (ch. ATCP 30, Wis. Adm. Code). This evaluation is required in ATCP 30 and will attempt to determine if a "statistically significant change" has occurred in groundwater concentrations of atrazine and its three chlorinated metabolites between Phases 1 and 2 of the survey. The focus of this evaluation is groundwater exploitable by private water supply wells. In Phase 1, DATCP sampled 289 wells that were selected using a stratified-random process. Results indicated that atrazine is present in about 12% of private wells and alachlor ESA is present in about 7% of wells. Nitrate contamination above 10 ppm can be expected in approximately 10% of state wells. Phase 1 samples will establish a statistically reliable basis for comparison with samples that will be collected in 1996 for Phase 2.

Previous DATCP and DNR surveys have identified significant point sources of contamination of groundwater quality at pesticide storage and handling facilities. These surveys indicated that activities at these sites have and continue to result in groundwater contamination, putting nearby private and, in some cases, municipal wells at risk. Surface water run-off from contaminated areas can also result in direct human and livestock exposure, property damage and/or surface water contamination.

In August 1993, section 94.73 of the Wisconsin Statutes was created and established the Agricultural Chemical Cleanup Program (ACCP) to address these point sources of contamination. The ACCP reimburses responsible parties for cleanup costs related to pesticide and fertilizer contamination at facilities and in nearby wells. Point source contamination on farms may also be handled by the program. To date, over 200 cases involving soil and/or groundwater remediation related to spills, misuse, and improper storage, mixing or loading have been initiated at pesticide and fertilizer handling facilities and on farms.

The ACCP also funds DATCP oversight of pesticide and fertilizer cleanup activities. Program staff investigate pesticide and fertilizer contaminated sites throughout the state. Investigations at these sites are prioritized based on suspected contamination levels, with higher levels investigated first. Investigations include discussions with facility staff or farmers to determine the most likely locations of contamination at the site. Other oversight activities include, but are not limited to, sample collection, laboratory analysis, and financial auditing.

DATCP solely funded three pesticide research projects during FY 95 and cooperatively funded one project each with the University of Wisconsin system and the DNR. DATCP's research fund, which is based on fees paid by pesticide manufacturers, provides approximately \$135,000 annually to meet pesticide related research needs of the Department.

DATCP, through its soil and water resource management program, provides funding primarily to counties to assist in the protection of these resources. An increasing portion of this funding is dedicated to the development and implementation of improved nutrient and pesticide management practices. Approximately \$200,000 has been provided to develop and demonstrate better management practices for nutrients and pesticides.

In FY 95 DATCP provided \$454,818 to fund projects in 18 counties for collection and disposal of waste pesticides and containers. More than 107,000 pounds of wastes were collected from farm sites, thereby reducing the potential for inadvertent environmental damage. DATCP is requesting additional proposals from counties for the 1996 fiscal year. Approximately \$560,400 will be available during FY 96 for these projects.

For further information, contact Mr. Nicholas Neher, DATCP, 2811 Agriculture Drive, Madison, Wisconsin, 53708-8911; phone 608-224-4567.

## DEPARTMENT OF INDUSTRY, LABOR AND HUMAN RELATIONS

Private Sewage Systems - The Department of Industry, Labor & Human Relations (DILHR) has drafted revised private sewage system regulations that will be embodied in ch. 151R 83, Wis. Adm. Code. The revised code is performance-based; that is, the private sewage system code focuses on the quality of the end products and allows designers and owners options to meet these quality standards. There is a trade-off, however, in return for this flexibility, owners are required to enter into contracts with management entities to ensure the long-term maintenance of their private sewage systems as specified by DILHR. The regulations were taken to public hearing, and were not received well. The public hearings and subsequent 6,000 written exhibits received by DILHR and legislators prompted reconsideration of the both the proposed regulations and requirements provided by the groundwater protection standards law, ch. 160, Stats. Ultimately, DILHR was empowered to finalize the new performance-based code. Officials and staff are now working on changes to coincide with directions contained in budget amendments.

DILHR has completed its research at the Black River Falls Correctional Institute. In conjunction with a private consultant and the University of Wisconsin-Small Scale Waste Management Project, DILHR tested alternative designs. The researchers found that recirculating sand filters can provide for nitrogen removal while peat filters were not effective in removing nitrogen from wastewater.

DILHR is completing efforts with the DNR to study the feasibility of a decentralized wastewater management system for Washington Island. The pilot project, which uses nitrogen-removal private sewage systems under municipal management, may be a model other communities can consider if the project is successful. These systems show promise; they come close to meeting the groundwater protection standard for total nitrogen. The Department assessed the potential treatment credit, if any, that can be recognized as the effluent moves through native soils. DILHR will allow Islanders to use a combination of treatment and soil dispersal to meet groundwater protection standards.

UWS researchers completed a study of septic system efficiency in the deep mottled silt soils typical of southwestern Wisconsin. They found that wastewater treatment is completed in the first few inches of soil; little effluent was discerned beyond the first few inches. The data will be used to develop alternative siting criteria for private sewage systems located in these soils.

Petroleum Storage Tanks - Through the Bureau of Petroleum Inspection and Fire Protection, DILHR continues the implementation of the Flammable and Combustible Liquids code, ch. DHSR 10, Wis. Adm. Code. In FY 95, the main program objectives continue to be verifying that tank owners are meeting their leak detection responsibilities, increasing the number of annual inspections conducted at facilities having tank systems, and completing implementation of the network of local program inspectors.

Owners meeting their leak detection responsibilities are identified through a use permit system and annual on-site inspections. Because of this effort, compliance with the leak detection requirements of the state and federal code has increased significantly. Closure of substandard and older tanks has also been impacted by this effort. Since 1988, over 59,591 federally regulated tanks systems have been closed.

The focus on annual inspections has involved establishing a network of local inspectors and inspection of retail service stations by the Bureau's petroleum inspectors. The petroleum inspectors examine retail sites for product quality and compliance with the groundwater protection provisions of ch. DHSR 10. The retail sites inspected by this network is 45 percent of the federally regulated underground storage tanks (USTs) found in Wisconsin.

Inspection of non-retail sites is conducted by local program operators who contract with DILHR to perform inspections. This network continues to grow and provide service throughout the state. In FY 95, the Bureau completed a bid process to obtain coverage for the remaining areas of the state not covered by voluntary agreements.

The Petroleum Environmental Clean-up Fund Act (PECUFA) program, which has been in operation since 1988, continued to implement cost control strategies detailed in administrative rule, ch. DHSR 47, Wis. Adm. Code. The main elements of the rule include:

1. Requiring owners to compare proposals before hiring a consultant.
2. Limiting consultants to providing consulting services when they have been hired to remediate a site.
3. Requiring non-consulting services be contracted through a competitive bid process.
4. Establishing the maximum award that will be paid for a site investigation unless DILHR approval is obtained for additional costs.
5. Requiring consultants and consulting firms to register with the DILHR and meet certain standards to perform work under the PECUFA program.
6. Verifying program costs claimed by owners by financial audits.

The PECUFA program was expanded in 1994 to include limited coverages for small farm tanks and heating oil tank systems for schools. In addition, coverages were increased for above ground tank systems.

For more information, contact Mr. Bennette Burks, DILHR, P. O. Box 7969, Madison, Wisconsin 53707-7969, phone: 608-266-0056, fax: 608-267-0592.

## DEPARTMENT OF HEALTH AND SOCIAL SERVICES

Chapter 160, Wis. Stats., directs the Department of Health and Social Services (DHSS) to recommend health-based enforcement standards for substances found in groundwater and specifies the protocol for developing the recommended standards. DHSS prepares recommended standards for the substances at the top of a prioritized list identified by the DNR. DHSS sends the recommendations to the DNR which proceeds through the rule-making process to amend ch. NR 140, Wis. Adm. Code. In October 1993, DHSS sent draft recommendations for 13 new groundwater standards. In addition, recommendations were made to revise existing standards for 10 substances. Authorization to subject these recommendations to public hearings was considered by the DNR board in August 1994. Hearings occurred in November 1994 and standards were approved by the DNR board and the Legislature in early 1995. The amendments will become effective in September, 1995.

The DHSS distributed research funds to the University of Wisconsin - Green Bay for a study of the health effects of consuming arsenic-contaminated water in Outagamie and Winnebago Counties. DHSS funded a graduate student to organize water sampling in the area, distribute a health survey and analyze the results. The study was completed in 1994 and the results, which did not indicate acute health effects from consuming arsenic-contaminated ground water, were distributed to the community.

DHSS staff review copies of advisory letters sent to well owners by DNR representatives. The agency often provides additional advice and information to owners of wells which are seriously contaminated with toxic substances such as benzene. Followup letters sent by DHSS explain the health effects of the specific contaminant and advise the homeowner regarding continued use of the water for bathing, laundry, etc.

The DHSS is responsible for investigating suspected cases of water-related illness. During the past year investigations have been conducted to examine the health effects of exposure to copper-contaminated water.

DHSS staff are listed on literature distributed by other agencies as resources for health risk information and handle several telephone calls each week answering questions about the health risks associated with consumption and household use of contaminated water. Toxicologists, public health educators, and epidemiologists employed by DHSS frequently present health-risk information at public meetings. They also prepare and distribute a wide variety of informational materials.

For more information, contact Dr. Henry Anderson, 1414 E. Washington Ave., Rm.96, Madison, Wisconsin, 53703-3044; phone: 608-266-1253.

## GEOLOGICAL AND NATURAL HISTORY SURVEY

The Wisconsin Geological and Natural History Survey (WGNHS) performs basic and applied groundwater research and provides technical assistance, maps, and other information and education to aid in the management of groundwater resources. The WGNHS groundwater

program is complemented by geology, soils, and climate programs that provide maps and research-based information essential to the understanding of groundwater occurrence, quality, and movement. WGNHIS personnel are presently preparing groundwater-related maps (such as water-table or aquifer maps) at a scale of 1:100,000 for Racine, Kenosha, Waukesha, Dane, Ozaukee, Pierce, Washington, Fond du Lac, La Crosse, Buffalo, Trempealeau, Eau Claire, Walworth, Polk, Burnett, Oconto, and Lincoln Counties.

In FY 95, the WGNHIS continued to respond to requests for information and assistance from other local, state, and federal agencies, consultants, students, and the public. These requests ranged from the simple, "What will I find underground if I dig or drill here?", to the more complex, such as questions about groundwater flow and contaminant transport in areas of agricultural chemical use or wellhead protection.

Public information, records, and research results that the WGNHIS stores and disseminates save the considerable expense of gathering the same geologic or groundwater information several times for different purposes, or "re-discovering" the same information over time. To help this service, the WGNHIS continues to review, sort and catalog about 18,000 well construction reports per year (in cooperation with the DNR), measure monthly groundwater levels in a monitoring network of 206 wells (in cooperation with the U. S. Geological Survey), collect, and describe geologic samples from 300 wells per year, and collect and analyze approximately 600 groundwater samples per year for nitrate, chloride, and several other basic parameters.

Research projects completed this year or in progress include:

1. Groundwater flow and quality in fractured dolomite in Door County.
2. Hydrogeologic and engineering properties of glacial materials.
3. Age, origin, and movement of groundwater in low-permeability materials.
4. Hydrogeology of Dane County.
5. Hydrogeology of Southeast Wisconsin.
6. Delineation of hydrogeologic units throughout Wisconsin.
7. Extent of atrazine contamination in the lower Wisconsin River valley.
8. Soils, geologic, and hydrogeologic setting for atrazine movement in Dane County.
9. Distribution of radionuclides in Wisconsin groundwater.
10. Hydrogeology and groundwater use, and quality of the Fox Cities area.
11. Evaluation of several groundwater susceptibility models and methods.

For more information, contact Mr. Ron Hennings, WGNHIS, 3817 Mineral Point Road, Madison, Wisconsin, 53705-5100; phone: 608-263-7395.

## DEPARTMENT OF TRANSPORTATION

The Department of Transportation (DOT) regulates the storage of highway salt under ss. 85.17 and 85.18, Wis. Stats., for the purpose of protecting the waters of the state from harm due to contamination by dissolved chloride. Additional groundwater management and protection related activities performed by DOT as part of the design, construction, and maintenance process of state and federal highways include: road salt research; hazardous materials (petroleum) and hazardous waste investigation and remediation; wetland compensation; and erosion control and storm water management. The responsibility for the management of these activities is divided among several groups in DOT:

- \*Salt Storage - Central Office and District Maintenance Sections
- \*Salt Research - Central Office Materials Section
- \*Hazardous Materials (petroleum) - Office of Environmental Analysis and District Environmental Coordinators
- \*Hazardous Waste - Risk & Safety Management Section
- \*Wetlands - Office of Environmental Analysis and District Environmental Coordinators
- \*Erosion Control and Storm Water Management - Office of Environmental Analysis and District Environmental Coordinators.

Salt Storage and Road Application - Highway salt is stored statewide at various sites by suppliers, counties, cities, villages, and private companies. Annual inspections and reports are made of salt storage sites to insure that storage practices are in accordance with ch. Trans 277, Wis. Adm. Code (Highway Salt Storage Requirements). The intent of the Code is to help prevent entry of highway salts into waters of the state from storage facilities. All salt must be stored on a base which is constructed and maintained to be impermeable. The base is required to function as a holding basin and to prevent runoff. All salt piles must be covered by impermeable materials or structures to prevent contact with precipitation.

Current policy in the State Highway Maintenance Manual restricts the spreading of deicer salts to a maximum of 300 pounds per lane mile per application. Electronic controls for salt spreader trucks are continually being tested to record and verify application rates and coverage effectiveness. Additional efforts to minimize and conserve salt applications are being pursued by use of an *in situ* weather monitoring system consisting of temperature sensors and remote processing units which determine and record temperatures of road pavement at approximately 30 separate statewide locations along major highway routes. The pavement temperature information determines the optimal sand:salt ratio applications. Also, annual training for proper snowplowing and salt spreading techniques is provided for county snow-plow operators, and the counties provide weekly reports of salt usage.

Salt Research - Since 1970, DOT has investigated potential road salt impacts on the environment adjacent to highways. Early investigations (1970s to early 80s) were focused on evaluating road salt impacts to surface water runoff, vegetation, and soils. In the last several years DOT has conducted limited investigations evaluating road salt impacts to groundwater (1 or 2 shallow monitoring wells per site). To date approximately 18 sites throughout the state have been studied. In general, each site is monitored quarterly for a period of 5 years. The monitoring consists of analyzing soil, water, or vegetation samples for calcium, sodium, chloride, and electrical conductivity. Approximately 5 sites are currently monitored, and future groundwater monitoring plans are being evaluated (i.e., longer monitoring periods and multiple well arrangements per site). Results from earlier studies are discussed in four separate DOT progress reports entitled:

Investigation of Road Salt Content of Soil, Water and Vegetation Adjacent to Highways in Wisconsin (1972, 1975, 1979, and 1989). The completion date of an updated progress report (Report 5) is unknown at this time.

Hazardous Materials (Petroleum) and Hazardous Waste - As part of the road construction program, DOT performs an estimated 200 to 400 environmental assessments annually along right-of-way where potential sources of petroleum or hazardous waste contamination may occur. Assessments consist of standard environmental audits of properties adjacent to highways, and environmental drilling and sampling to identify or delineate the extent of soil or groundwater contamination. Numerous contaminated sites are identified as part of the environmental assessment process. This information is shared with the DNR so that appropriate enforcement and remedial action is taken to protect groundwater resources. In addition, DOT works with DNR and DILHR on 20 to 40 sites per year where underground storage tank removal or other remedial actions are necessary to accomplish highway improvement (i.e., managing the removal, treatment, and disposal of contaminated soils or groundwater).

Wetlands - During the past 5 years, DOT has engaged in a cooperative study with the U. S. Geological Survey to investigate groundwater relationships with respect to wetland creation and restoration projects. The projects are required as compensatory mitigation under section 404 of the Clean Water Act. The groundwater studies are intended to increase the certainty of establishing wetland hydrology. In addition, DOT has several ongoing wetland monitoring projects which evaluate wetland hydrology and water quality.

Since July 1993, DOT has had an interagency approved wetland mitigation banking program. Currently wetland lost due to highway, bridge and airport projects are being compensated on 13 constructed wetland bank sites. At this time the estimated total restored wetland for these sites is 1509 acres. Twenty-five new bank sites are under development. Depending on the nature of the site, some component of groundwater, water chemistry, and vegetational monitoring is conducted on several of the DOT wetland bank sites.

Erosion Control and Storm Water Management - The DOT has established erosion control standards for airport, railroad, and highway construction projects as well as maintenance projects administered by the DOT. These standards were created to minimize on-site erosion damage and to minimize adverse impacts on the waters of the state resulting from sediment or pollutant accumulation. Construction projects must adhere to best management practices, performance standards, and erosion control implementation as stated in ch. Trans. 401 Adm. Code. Best management practices, given in Chapter 10 of the Facilities Development Manual of the DOT, include devices and procedures employed to minimize erosion. Best management practices were developed in consultation with the DNR, FHWA and the road building industry.

Chapter 10 of the Facilities Development manual of the DOT is being revised to include management of storm water runoff from transportation facilities. Proposed revisions include quantitative and qualitative runoff issues. The revised Facilities Development Manual is to be completed in 1997 with the interim storm water management policy to be published by the end of 1995. Currently, storm water best management practices are being incorporated on a case by case basis with priority being given to transportation facilities project design.

For more information, contact Ms. Carol Cutshall, DOT, Room 451, P. O. Box 7916, Madison, Wisconsin 53707-7916; phone: 608-266-9626.

## UNIVERSITY OF WISCONSIN SYSTEM

The University of Wisconsin System (UWS) has research, teaching and information/education responsibilities. The three missions are integrated through cooperation and joint appointments of teaching, research, and extension personnel who work on groundwater issues.

Research - During FY 95 the UWS has directed a wide-ranging program of priority groundwater research consisting of 15 projects. The projects include short-term and long-term studies, and may be either of a fundamental or an applied nature. They provide a balanced program of laboratory, field, and computer-modeling investigations and applications aimed at preserving or improving groundwater quality. Among the categories of groundwater problems investigated are:

- a. Transport of contaminants in soils and their dispersion in aquifers.
- b. Occurrence and sources of pesticides and their metabolites in groundwater.
- c. Improved management of agricultural chemicals, particularly pesticides and nitrates.
- d. Hydrogeologic field measurements and computer simulations.
- e. New and improved technologies for remediation of contaminated waters.
- f. New and improved technologies for waste management.
- g. Biological effects of pollutants and more cost-effective bioassays for pesticides.
- h. Improvements in on-site disposal systems and reduction of nitrate flux from septic systems.
- i. Groundwater protection from arsenic and volatile organic compounds.

The 15 projects funded provided training in several disciplines for postdoctoral research associates, graduate student research assistants, and undergraduate students. A complete list of research projects funded during FY 95, the principal investigators, and project durations are found in Table 1. Table 2 provides a similar list of information for the 14 projects scheduled for funding during FY 96. In addition to these projects, UWS initiated a major project during FY 95, that is aimed at publication, distribution, and computerized dissemination of research findings resulting from its groundwater research program. Final technical reports, and 2-page executive and technical summaries of all completed UWS groundwater research projects back to FY 91 are being published for distribution to researchers, field specialists, state agency and academic libraries, environmental consulting firms, legislative personnel, and citizens groups. This exercise is part of a coordinated effort being undertaken in conjunction with DNR, DILHR, and DATCP to enhance the utility of research findings resulting from studies funded through the Wisconsin Joint Solicitation process with advice from the UWS Groundwater Research Advisory Council and program planning from the Wisconsin Groundwater Coordinating Council. The effort is well underway and will be up to date with current incoming final project reports by the end of calendar year 1995.

Teaching - The UWS institutions continue to offer courses and programs at the undergraduate and graduate level focusing on groundwater resources. In addition, several campuses offer credit, field-oriented water curriculum courses for middle school and high school teachers during summer sessions.

Information/Education - The UWS institutions and county-based staff continue involvement in groundwater education activities. In cooperation with other state and federal agencies, groups and individuals, innovative problem-solving educational programs on groundwater resources are provided to the State's citizens through publications, meetings, teleconferences, satellite



programs, water testing, and other forms of assistance. Activities of several specific programs follow.

The UWS farm assessment system (Farm\*It\*Syst) and home assessment system (Home\*It\*Syst) programs help farmers and rural non-farm residents assess the relationship of their structures, management practices, and site characteristics, to groundwater pollution potential. The system has been applied in depth in seven Wisconsin counties, integrated into at least three Wisconsin Priority Watershed projects and is under consideration as a major part of the educational plan for other projects. A pollution prevention delivery system based on Farm\*It\*Syst is being developed in cooperation with farm supply groups and other businesses. Project evaluation shows Farm\*It\*Syst to be an effective, voluntary program which increases knowledge and, most importantly, leads to changes in practices. The expanded, national project is already working with all 50 states and several Canadian provinces in adopting this system. The National Comprehensive Groundwater Protection Guidance document encourages states to develop a cooperative Farm\*It\*Syst program. This is a cooperative project funded by the U.S. Department of Agriculture (USDA) Cooperative State Research Education Extension Service, the Natural Resources Conservation Service, and the EPA.

The USDA Water Quality Demonstration Project in the East River Watershed (Green Bay) is adopting research-based practices for cost-effective water quality protection. This year's educational emphasis has been on manure handling, private well protection, milkhouse waste reduction, integrated crop management, and fuel and pesticide storage. Use of specific crediting of nutrients from applied manure has resulted in a reduction in use of phosphorus and nitrogen on corn fields. Resulting economic savings of \$10 to \$20 per corn acre has impressed farmers.

The USDA Hydrologic Unit (Stevens Point, Whiting, and Plover Wellhead Protection) project in Portage county applies innovative, research-based practices to maintain or improve the communities' well-water supply. Agricultural practices, such as irrigation water management and reducing fertilizer and pesticide use complement an urban groundwater protection component in the project's educational and technical assistance efforts. This is the second year of a 3-year program that comprehensively manages crop nutrients and pests, resulting in reduction of fertilizer and pesticide applications. Farmers in the project reduced inputs of nitrogen fertilizers, a source of nitrate contamination.

The UW Nutrient and Pest Management (NPM) program is engaged in 38 on-farm demonstration and field day activities to disseminate information on best management practices (BMPs) around the state. The program helps landowners understand how their farm practices may influence the quality of groundwater. Another incentive is farm profitability. Over the past five growing seasons, NPM regional specialists established 176 demonstrations on 80 farms statewide. Overall, 83% of the improved management practice demonstrations were more profitable than the standard practices to which they were compared.

The UWS cooperates with other state agencies involved in the Non-point Source Water Pollution Abatement program (Priority Watershed Program). This program improves water quality by providing education and technical assistance, and financial assistance through cost-sharing for BMPs to improve water quality in over 65 watersheds. Several projects incorporate groundwater education strategies into their overall information and education programs. Six Area Water Quality Education Specialists and three publication/editorial staff work with County Extension Agents and Land Conservation staff in educating rural and urban residents. A common element to the program strategies used in these projects is well water testing and groundwater education.

Additionally, this educational programming includes drinking water fact sheets, newsletter articles about groundwater and, in some instances, specific watershed studies that address unique water quality problems (e.g., elevated levels of arsenic in drinking water samples from Door County).

To address issues related to water resources, Cooperative Extension formed the Extension Water Resources Coordinating Council (EW RCC) which has conducted several projects aimed at:

1. Maintaining an inventory of water-related programs and research,
2. enhancing internal communication,
3. assisting in priority-setting,
4. facilitating external coordination; and
5. fostering water resources education which integrates county and state staff expertise.

In the past year, the EW RCC has sponsored informational resources for those providing groundwater programming. These inventories have included:

1. Listing of committees, councils, and advisory groups which have work tasks related to water resources,
2. a national directory of electronic bulletin boards and databases that provide information about water resources topics; and
3. a directory of newsletter and periodic bulletins which contain water-related information.

The EW RCC publishes a monthly newsletter called Keeping Current which brings information about water-related issues to more than 1,000 agency personnel in Wisconsin.

The Central Wisconsin Groundwater Center's (CWGC) mission is to provide groundwater education and technical assistance to the citizens and governments of Wisconsin. Center programs range in breadth from answering citizen questions (i.e. is my water safe? how deep should I drill my well? where is this nitrate coming from?) to helping communities with wellhead protection planning to describing the extent and causes of groundwater nonpoint pollution in Wisconsin. The Center frequently works through county Extension faculty in program delivery.

Last year, the Center assisted 2,791 households in having their water tested in conjunction with county Extension offices and the UWSP Environmental Task Force Laboratory. Of these, 10% exceeded the drinking water standard for nitrate-nitrogen. Twelve percent were unsafe because of coliform bacteria. Twenty-six percent had moderate to severe corrosivity indices. Education programs helped many families understand potential remedies for these problems and the relationship of land use practices to groundwater quality.

Other projects include studying agricultural loading in the Central Sands; basin-scale modeling of contaminant loading and migration to the Stevens Point, Whiting, and Plover wells; grant-funded workshops which provided sand-tank groundwater flow models to 26 Central Wisconsin schools; and completion and distribution of Home Water Safety educational materials.

For more information, contact Dr. G. Earl Peace, UW System, 1220 Linden Drive, Madison, WI 53706; phone (608) 262-5851.

## **LISTING OF GROUNDWATER-RELATED PUBLICATIONS FOR FISCAL YEAR 1995**

Published by the UW System: A- series bulletins are available from UW-Extension Publications, 30 N. Murray St., Madison, WI 53706.

Nowak, P. J., et al "The Effectiveness and Impacts of the Wisconsin Atrazine Rule" DATCP Tech. Rept., Madison, WI, 101 pp

Keeping Current A newsletter published by UWEX to provide a monthly update on Wisconsin water resource programs and issues.

Soil Nitrate Tests for Wisconsin Cropping Systems: A Guide for Using the Preplant and Pre-Sidedress Nitrate Tests A3624

Credit What You Spread - and Reap the Profits A3580

Credit Nitrogen on Corn - and Reap the Profits A3589

Wisconsin's Pre-Sidedress Nitrate Test A3630

Corn Rootworm Pest Identification A3631

1993 NPM On-Farm Demonstrations: Farming for Water Quality and Profits A3542

Field Notes A newsletter published by NPM, eight times per year

Nutrient & Pest Management Practices - 29 slides and speaker notes (contact NPM)

Manure Hauling Records (contact NPM)

Farm Smart - Credit Manure Dial (contact NPM)

### Publications and Reports by the Central Wisconsin Groundwater Center:

Balma, J.A., G.J. Kraft and W. Stites, 1994. Land use impacts on Groundwater Quality in the Port Edwards Priority Watershed. Proceedings of the 19th annual meeting of the American Water Resources Association - Wisconsin Section.

Kraft, G.J., 1994. Do BMPs Really Protect Groundwater? A Central Wisconsin Experience. Proceedings of the national symposium on protecting rural America's water resources. Groundwater Protection Council.

Mechenich, D.J., and G.J. Kraft, 1994. Contaminant Source Assessment and Management Using Groundwater Flow and Contaminant Models in the Stevens Point-Whiting-Plover Wellhead Protection Area. Proceedings of the 19th annual meeting of the American Water Resources Association - Wisconsin Section

Stites, W., 1994. Nitrate Leaching Under an Irrigated Vegetable Field in Wisconsin's Central Sands. Proceedings of the 19th annual meeting of the American Water Resources Association - Wisconsin Section.

#### Reports Published by UW-Madison Water Resources Center During FY 95

Adams, T. M., P. J. Bosscher, C. F. Joerges, C. Chung, K. Kim, N. Majmudar, and A. Tang. 1994. Integrated Decision Support for Wellhead Protection. *WRC GRR 94-01*. Department of Civil and Environmental Engineering, UW-Madison. 33 pp.

Meigs, L. C., and J. M. Bahr. 1994. Tracer Study in a Complex Three-Dimensional Flow System. *WRC GRR 94-02*. Department of Geology and Geophysics, UW-Madison. 21 pp.

Bahr, J. M., and L. C. Meigs. 1994. Transport of Agricultural Contaminants in Sand Aquifers Affected by Drainage Ditches. *WRC GRR 94-03*. Department of Geology and Geophysics, UW-Madison. 24 pp.

Christensen, C. R., and D. S. Cherkauer. 1994. *In situ* Removal of Iron, Manganese, and Radium from Groundwater. *WRC GRR 94-04*. Departments of Civil Engineering and Mechanics and Geosciences, UW-Milwaukee. 28 pp.

Niken, J. M., and D. M. Mickelson. 1995. Three-dimensional Characterization of Hydraulic Properties of a Coarse Glacial Outwash Deposit. *WRC GRR 95-01*. Department of Geology and Geophysics, UW-Madison. 19 pp.

Grundl, T. J. 1995. The Adsorptive Behavior of Atrazine and Alachlor in Organic-poor Sediments. *WRC GRR 95-02*. Department of Geosciences, UW-Milwaukee. 17 pp.

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Rayne, T. W., D. M. Mickelson, and K. R. Bradbury. 1995. Variability of Hydraulic Conductivity in Sandy Till: True Variation versus Method. *WRC GRR 95-04*. Department of Geology and Geophysics, UW-Madison and Wisconsin Geological and Natural History Survey, UW-Extension. 36 pp

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Water-table map of Dane County: 6 p. report plus 18 plates (scale 1:24,000). Plate 1: Deerfield Quadrangle. Plate 2: Mt. Vernon Quadrangle. Plate 3: Verona Quadrangle. Plate 4: Oregon Quadrangle. Plate 5: Rutland Quadrangle. Plate 6: Stoughton Quadrangle. Plate 7: Rockdale Quadrangle. Plate 8: Black Earth Quadrangle. Plate 9: Springfield Corners Quadrangle. Plate 11: De Forest Quadrangle. Plate 12: Sun Prairie Quadrangle. Plate 13: Marshall Quadrangle. Plate 14: Cross Plains Quadrangle. Plate 15: Middleton Quadrangle. Plate 16: Madison west Quadrangle. Plate 17: Madison East Quadrangle. Plate 18: Cottage Grove Quadrangle.

Precipitation summary for 1994: 6 p. report

Groundwater levels in Wisconsin, annual summary 1994 6 p. report.

Groundwater quality investigation maps of Pepin County, Wisconsin: 6 plates (scale 1:100,000). Plate 1: Nitrate as Nitrogen in mg/L. Plate 2: Chloride in mg/L. Plate 3: Laboratory Measurement of Alkalinity in mg/L. Plate 4: Total Hardness in mg/L. Plate 5: Laboratory Measurement of Electrical Conductivity. Plate 6: Ferrous Iron in mg/L.

Depth to bedrock map of Pepin County, Wisconsin: two-color map (scale 1:100,000).

# GROUNDWATER MONITORING AND RESEARCH

## CONDITION OF THE RESOURCE - GROUNDWATER QUALITY

As part of 1983 Wisconsin Act 410, the Groundwater Account of the Environmental Fund was created to support groundwater monitoring by state agencies to determine the extent of groundwater contamination in Wisconsin and identify the sources of contamination. Groundwater monitoring has found that the primary contaminants of concern are volatile organic compounds (VOCs), pesticides and nitrates. Each is discussed below.

Volatile Organic Compounds - VOCs volatilize under normal ambient temperatures and pressures. Examples of VOCs include gasoline and industrial solvents, paints, paint thinners, drain cleaners, air fresheners and household products (such as spot and stain removers). Many VOCs are suspected carcinogens when exposure is long term. In the short term, high concentrations of VOCs can cause nausea, dizziness, tremors or other health problems.

Sources of VOCs include landfills, underground storage tanks, and hazardous substance spills. The Emergency and Remedial Response Section of the DNR conducts problem assessment and at-risk monitoring at state Environmental Repair Fund sites, abandoned facilities, CERCLA (superfund), LUST and spill sites. The DNR has sampled thousands of wells for VOCs. More than 60 different VOCs have been found in Wisconsin groundwater. Trichloroethylene is the VOC found most often in Wisconsin's groundwater.

Wisconsin has 101 active licensed solid waste landfills of which 99 are required to monitor groundwater. Two studies conducted over 4 years revealed that of 51 total landfills, including industrial and municipal landfills (both engineered and unengineered), 27 (53%) caused VOC contamination of groundwater. However, VOC contamination occurred in groundwater at 21 (81%) of the 26 unengineered municipal solid waste landfills included in the two studies. While 20 different VOCs were detected overall, 1,1-dichloroethane was the most commonly occurring VOC at all solid waste landfills. The two DNR publications: "Volatile Organic Compounds in Groundwater and Leachate at Wisconsin Landfills," dated February 1988, and "VOC Contamination at Selected Landfills - Sampling Results and Policy Implications" dated June 1989 further describe the research findings. In a follow-up VOC study conducted from July 1992 through June 1994, the DNR reviewed historical data and sampled groundwater at 11 closed, unengineered landfills and at six older, engineered landfills. VOC levels have decreased at all but two of the unengineered landfills though at many of the sites VOC levels do not show continued decline, and the level of contamination remains high at several sites. There was no VOC contamination attributable to leachate migration at any of the six older, engineered landfills.

Wisconsin requires underground storage tanks to be registered with DNR if their capacity is 60 gallons or more. This registration program has identified 151,865 tanks as of October 1993 in the state, of which 69,157 are regulated by the federal underground storage tank program. As of July 1994, approximately 37,450 federally regulated underground storage tanks have been removed. Currently there have been 3,940 underground storage tank clean-ups completed. There are approximately 7,800 currently active clean-ups. Of the active sites, 1,029 are in a long-term monitoring phase which precedes site close-out. The contaminants most commonly associated with leaking underground storage tanks (LUSTs) are components of gasoline and diesel fuel including benzene, toluene, ethyl benzene, and xylene (i.e. BTEX compounds). There are over

3,000 LUST sites with BTEX groundwater standards exceedences. Approximately 285 private water supply wells have been impacted by contamination from LUST sites.

Another VOC source is hazardous waste storage and handling facilities. The WDNR Hazardous Waste Section has 28 sites where investigation/remediation of contamination is taking place. There are a total of 140 sites statewide identified as subject to corrective action authorities. Not all 140 sites will be put into the corrective action process because of minimal contamination at the site or jurisdiction under other regulatory authorities.

VOC-containing petroleum products comprise 65 percent of all reported spills in Wisconsin. Section 144.76, Wis. Stats, the Hazardous Substance Spill Law requires those who spill hazardous substances to report spills and to take immediate actions necessary to restore the environment. The number of spills reported per year has increased from 360 during 1978 to around 1400 in 1993. Groundwater monitoring is performed when necessary to delineate the extent of contamination.

Pesticides - Pesticide contamination of groundwater may result from general field use according to label directions (i.e., nonpoint sources) or spills, misuse, or improper storage and disposal (i.e., point sources). Serious concerns about nonpoint sources of pesticide contamination in Wisconsin were first raised in 1980 when aldicarb was detected in groundwater near Stevens Point. DNR, DATCP and other agencies responded to these concerns by implementing monitoring programs and conducting groundwater surveys. DNR expanded its sampling programs in 1983 to include analysis of pesticides commonly used in Wisconsin. Federal and state groundwater quality standards for many of these compounds were also adopted, and, to date, standards for 30 pesticides are included in ch. NR 140 Wis. Adm. Code.

Beginning in 1985, DATCP installed approximately 150 monitoring wells at 50 highly susceptible sites across the state where pesticide use characteristics (e.g., specific compounds and application rates) are known. Data from these wells have been collected quarterly and are used to identify problem pesticides and field use activities that may contribute to groundwater contamination in Wisconsin. To date, the herbicide atrazine has been found at 29 of 40 monitoring sites, with the CS being exceeded at 12 sites. Alachlor (trade name Lasso) has been detected at 10 of 27 sites.

Since the late 1980s, DATCP has also initiated a number of surveys to investigate pesticides in groundwater resulting from nonpoint sources. In 1994, DATCP completed a groundwater survey of alachlor and its ethane sulfonic acid (ESA) metabolite in southern Wisconsin. The study was funded by DATCP, DNR and Monsanto, and was designed to determine the extent of alachlor and ESA contamination in Wisconsin private wells most at risk. The study was conducted in the following 11 counties where alachlor sales and use have been concentrated: Columbia, Dane, Dodge, Grant, Green, Jefferson, Iowa, Lafayette, Rock, Sauk and Walworth. Immunoassay test kits were sent to approximately 1500 homeowners whose wells had either a previous detection of triazines or nitrates over 10 ppm. A total of 669 samples were returned for immunoassay analysis at DATCP's Bureau of Laboratory Services. Triazines were detected in 45% of these samples. Well owners with a detection were offered free followup sampling and more comprehensive laboratory analysis for alachlor, ESA, nitrate, and other commonly used pesticides. Followup analysis indicated that approximately 1.8% of the original 669 wells had detections of alachlor and that 32% had detections of ESA. Alachlor was detected above the CS of 2.0 ppb in six followup samples, while ESA was detected above the Interim Health Advisory of 20 ppb in two followup samples. DATCP plans to conduct site investigations around wells with alachlor



exceedences of the CS or CSA exceedences of the Interim Health Advisory to identify the source(s) of groundwater contamination. Information from the investigations will be used to determine what actions DATCP will take in response to alachlor and CSA contamination in groundwater.

In 1994, DATCP also completed Phase 1 of a survey designed to evaluate the effectiveness of the atrazine rule (ch. ATCP 30, Wis. Adm. Code). This evaluation is required in ATCP 30 and will attempt to determine if a "statistically significant change" has occurred in groundwater concentrations of atrazine and its three chlorinated metabolites between Phases 1 and 2 of the survey. The focus of this evaluation is groundwater exploitable by private water supply wells. In Phase 1, DATCP collected 289 groundwater samples statewide to establish a statistically reliable basis for comparison with samples that will be collected in 1996 for Phase 2. The private wells were chosen using a stratified-random selection process, and groundwater samples were analyzed for atrazine, its breakdown products, and a number of other pesticides. Phase 1 survey results indicate that between 8.0% and 16.4% of wells in Wisconsin contain detectable levels of atrazine and/or its metabolites, with 0.6% to 2.8% exceeding the CS of 3.0 ppb. In addition, 4.2% to 9.4% of private water supply wells in Wisconsin had detections of alachlor's CSA metabolite. In addition, 50.7% to 67.8% of private wells contain nitrate, with between 6.7% and 13.1% exceeding the CS of 10 ppm.

DATCP also collects groundwater samples from private wells that are associated with pesticide investigations. Most of these investigations are initiated based on an exceedence of a pesticide CS in groundwater. DATCP investigators may take confirmation samples from the well with the exceedence or from wells on adjacent property. The sample data help DATCP identify probable sources of pesticides in groundwater, provide background water quality information and assist in the development of regulatory actions, such as Atrazine Rule amendments.

In addition to nonpoint sources of pesticides in groundwater, a significant point source problem was identified during two surveys of groundwater quality at pesticide storage and handling facilities. The Agricultural Chemical Cleanup Program (ACCP), administered by DATCP, was created primarily to address point source contamination at these facilities and in nearby wells. Point source contamination on farms is also handled by ACCP. To date, over 200 cases involving soil or groundwater remediation related to spills, misuse, improper storage and other point sources have been initiated at facilities and farms. Monitoring groundwater from adjacent private wells and/or installation of monitoring wells are often associated with these cases.

Triazine Screening - Triazines are a class of herbicides which include atrazine and simazine. Beginning in January of 1991 the Wisconsin State Laboratory of Hygiene (SLDH) initiated a testing program for the public based on the immunoassay screening test for triazine based compounds. This program is available to the public using a toll-free telephone number. Since the start of this program, approximately 10,000 groundwater samples have been screened for triazine compounds. The SLDH has expanded the immunoassay screening program to include other pesticides as requested.

Data from the SLDH program indicates that approximately 18% of the samples have exceeded the PRL for atrazine of 0.3 ppb, and approximately 2.2% have exceeded the CS of 3.0 ppb for atrazine. These numbers are used only for reference since the test screens for compounds other than atrazine specifically and does not screen for two of the three breakdown metabolites included in the groundwater standard.

Nitrate - Nitrate-nitrogen is the most commonly found groundwater contaminant, and frequently exceeds the state drinking water standard and CS of 10 milligrams/liter (mg/l) nitrate + nitrite nitrogen. Nitrate + nitrite nitrogen will henceforth be referred to as nitrate. Consumption of water containing high concentrations of nitrate by infants under 6 months can induce methemoglobinemia or "blue baby syndrome," a condition in which hemoglobin is oxidized to a form unable to carry oxygen to the body's tissues. All infants under 6 months of age are at risk of nitrate poisoning, but some babies may be more sensitive than others. Serious poisonings in infants have occurred following ingestion of water containing nitrate concentrations as low as 50 mg/l, just 5 times the current CS. Fatal poisonings usually involve ingestion of water containing 100-150 mg/l nitrate. The effects of ingesting lower concentrations are not known, but some experts believe this could cause a chronic oxygen shortage, which could injure an infant's nervous system. Some scientific studies have found evidence suggesting that women who drank nitrate contaminated water during pregnancy are more likely to have babies with birth defects. Nitrate ingested by the mother may also lower the amount of oxygen available to the fetus. Nitrate is not usually harmful to adults or older children, although scientists are unsure about the chronic health effects of nitrate, long term ingestion of water containing high nitrate levels is not recommended.

The DTHS and the DNR have recommended that all newly constructed private wells and wells that have not been tested during the past 5 years, be tested for nitrate. Testing is recommended for wells used by pregnant women and is essential for wells that serve infants under 6 months of age.

Nitrate can enter groundwater from many sources, including nitrogen based fertilizers, animal waste storage and feedlots, municipal and industrial wastewater and sludge disposal, refuse disposal areas, and private sewage systems. Recent studies have shown that approximately 10% of private wells in the state contain nitrate above the CS. This number can be highly variable between counties, but if true, 75,000 of Wisconsin's 750,000 wells exceed the standard of 10 mg/l of nitrate.

The 10% CS nitrate exceedance number was confirmed by work done through the WGNHS and the DTHS as a summary project using data from existing databases at the CWGWC, the USGS, the DATCP, the WGNHS, and the DNR. This summary work indicated that nitrate exceedance rate of the CS from each of these existing agency databases ranges from 9% to 14%, depending on the dataset being used. This data summary project was initiated to compare or validate the data from a U.S. Centers for Disease Control and Prevention (CDC) sampling project.

In response to widespread flooding in the summer of 1993 the CDC sponsored a private well sampling program across the 9 Midwestern flood affected states. DNR Water Supply staff took 636 private well samples with at least eight samples taken in each county. Each well was analyzed for nitrates, coliform bacteria, E. coli bacteria, atrazine, radon and some for sulfates and arsenic. A GIS coverage consisting of point locations for each private well sampled was created by the DNR Water Resources Management Program.

The CDC study showed that concentrations of nitrate in groundwater are not uniform across the state. Some undeveloped areas have low nitrate levels, whereas up to 50% of rural wells in some agricultural areas of southern Wisconsin exceed the CS for nitrate. County groundwater assessments conducted by the WGNHS have found private well nitrate results above the CS ranging from 2% in Burnett County to 16% in Pepin County. Data compiled for the "Nitrate in

Wisconsin's Groundwater: Strategies and Challenges" conference in 1994 shows a range of 0% for Forest County to 27% in Rock County. Most of the differences across the state can be related to variations in nitrogen loading and to differences in soil, geology and groundwater conditions.

Due to the concern over nitrate, the GCC endorsed a resolution in 1989 recommending that newly constructed water supply wells be sampled for nitrate in addition to coliform bacteria. Also, DNR continues evaluating state-of-the-art septic system designs for nitrate removal. DNR drafted revised private system regulations that would require compliance with the ground standards in NR 140. In addition, DNTCP has been evaluating the need for regulation of nitrogen-based fertilizers. The DNR and DHS produced a joint "Nitrate in Drinking Water" brochure to address nitrate education concerns.

Biological Hazards - The DNR is aware of several areas in Wisconsin where biological contamination of the aquifer is common. Biological agents include bacteria, viruses, and parasites. These agents can cause acute illness and result in life-threatening conditions for some population groups. Approximately 10 - 15% of water samples test positive for coliform bacteria, an indicator species of other biological agents. The DNR recommends that well owners test for biological quality annually or when there is a change in taste, color, or odor of the water.

Natural Groundwater Quality - Natural groundwater quality varies greatly throughout Wisconsin. Undesirable constituents commonly found in Wisconsin groundwater include iron, manganese, sulfate, arsenic, and radioactive compounds. High levels of iron have been detected throughout the state. High levels of manganese, arsenic and sulfates are less commonly found and are more localized in extent.

Naturally occurring radioactivity in groundwater, including uranium, radium and radon, have become a concern in Wisconsin in recent years. The state has initiated programs to test groundwater for radioactivity. Recent sampling has identified radionuclides in groundwater in north-central Wisconsin. High levels of radium have also been found in water supplies in eastern Wisconsin. Studies have been initiated to examine the occurrence and extent of these naturally occurring contaminants.

Two recent studies have examined the groundwater quality for radon in private wells. The first study, discussed earlier as the CDC Private Well Survey, sampled wells in a grid pattern across the state at 10 mile intervals. Data continue to indicate elevated concentrations of radon in north-central Wisconsin. This study is in the final write-up phase.

The second radon study currently under way is a study being conducted by DHS in conjunction with the Wisconsin Environmental Health Association (WEHA). This study involves selecting wells drawing water from specific geological formations. The formations of the state are currently being mapped by the WGNHS using a geographic information system. The data layer is called the Primary Bedrock Aquifer coverage. This mapping scheme will be used to select approximately 1,000 wells for radon sampling.

The CDC Private Well Survey sampled 97 wells for arsenic in the Lake Michigan District. Preliminary results indicated there were no CS exceedances from this sampling.

## CONDITION OF THE RESOURCE - GROUNDWATER QUANTITY

Groundwater is plentiful in most of Wisconsin. Widespread thick sequences of permeable deposits form four major aquifers that yield water to wells (Figure 1).

Figure 1 - The four major aquifers in Wisconsin

- 1) The sand and gravel aquifer consists of unconsolidated deposits of sand and gravel which are the surface deposits over about 70% of the state. The aquifer consists primarily of glacial deposits except in the driftless area in southwest Wisconsin where it occurs as valley alluvium within the flood plains of larger rivers. The sand and gravel is not continuous, but consists of lenses and layers of sand and gravel interspersed with other glacial deposits. Well yields are variable for this reason and depend on the permeability and thickness of the sand and gravel at a particular location.
- 2) The Silurian dolomite aquifer is limited to the eastern border of Wisconsin and consists mostly of dolomite with some shale. Well yields from this aquifer depend on the number of fractures and solution openings intersected by wells.
- 3) The sandstone aquifer consists of sandstones and dolomites which are present over the southern two-thirds of the state. This aquifer underlies the Silurian dolomite in eastern Wisconsin. It directly underlies the sand and gravel aquifer in north central Wisconsin and the sand and gravel aquifers in the rest of the state except for the driftless area in southwest Wisconsin where it is at the surface. The sandstone aquifer consists of rocks of Cambrian and Ordovician ages. Well yields from this thick, productive aquifer are high.
- 4) The crystalline bedrock aquifer underlies the entire state and consists primarily of granitic and metamorphic rocks of Precambrian age. Well yields from this aquifer are typically small and come from fractures in the rock.

Groundwater supplies serve more than 70 percent of Wisconsin's population, and is a primary source of water for agriculture and the sole source of private water supplies. Estimated daily use of groundwater in Wisconsin is about 600 million gallons. The quantity of available groundwater is affected by withdrawals, discharge to surface water bodies, and recharge. Approximately 14 billion gallons of water is recharged to groundwater every day. Despite this general abundance of groundwater, there have been a number of concerns raised in recent years about the quantity of high quality groundwater available for people's use and for replenishing lakes, streams, and wetlands.

In some areas, it may be difficult to find an adequate supply of good quality groundwater because of impermeable aquifer materials, naturally-occurring substances, or manmade contaminants. The occurrence and availability of groundwater differs considerably from area to area, depending on the character and thickness of water-bearing rocks and their connection with underlying and overlying rocks, soil characteristics, surface water discharges, and other groundwater withdrawals for consumptive or dewatering operations. The rate of groundwater recharge varies correspondingly from nearly zero in parts of eastern Wisconsin where there are mainly impermeable soils, to as much as 50 percent of annual precipitation in the central portions of the state where sandy glacial deposits cover the surface and allow rain water to reach groundwater.

A part of north-central Wisconsin is underlain by poorly productive, fractured crystalline rocks (see Figure 2) where the sand and gravel aquifer is thin or absent. In this area, yields of groundwater during dry seasons are too low in some places to sustain large water supplies. However, yields adequate for domestic wells can usually be found.

There has also been increasing concern in recent years about the impact of groundwater withdrawals on surface waters and aquifers of the state. For example, groundwater levels are declining slowly in local areas of concentrated pumping of high capacity wells, primarily in southeastern Wisconsin, the Lower Fox River Valley and Dane County (see Figure 2). This has increased the cost of pumping groundwater but does not appear to have resulted in dewatering of the aquifers yet. Concerns have been raised about the long-term potential for groundwater withdrawals from these aquifers.

There have been other impacts from groundwater withdrawals as well. Streamflow in the Little Plover River in the Central Sands has decreased due to groundwater withdrawals from high capacity wells. Water levels have been affected by mine dewatering in the lead mining district in southwestern Wisconsin. There have been concerns about impacts on wetlands in southeastern Wisconsin due to withdrawals from nearby high capacity wells. A primary source of the groundwater withdrawals are the over 8,000 high capacity wells in the state; these are wells which pump over 100,000 gallons per day or 70 gallons per minute. To better understand the groundwater quantity issue, the GCC has asked that a report be prepared to evaluate available information on groundwater quantity impacts, identify where information is lacking and consider options for dealing with groundwater quantity problems. The report will be completed in FY 96.

Effective management of groundwater in Wisconsin requires up-to-date information on groundwater levels and their fluctuations and trends. A number of efforts are being made to gather information on groundwater quantity issues. The WGNHS and the U.S. Geological Survey (USGS) initiated a statewide water-level observation network in 1946 to gather this information. Water-level measurements are checked and entered into a computer data base. Statewide summaries of groundwater level trends are published annually or

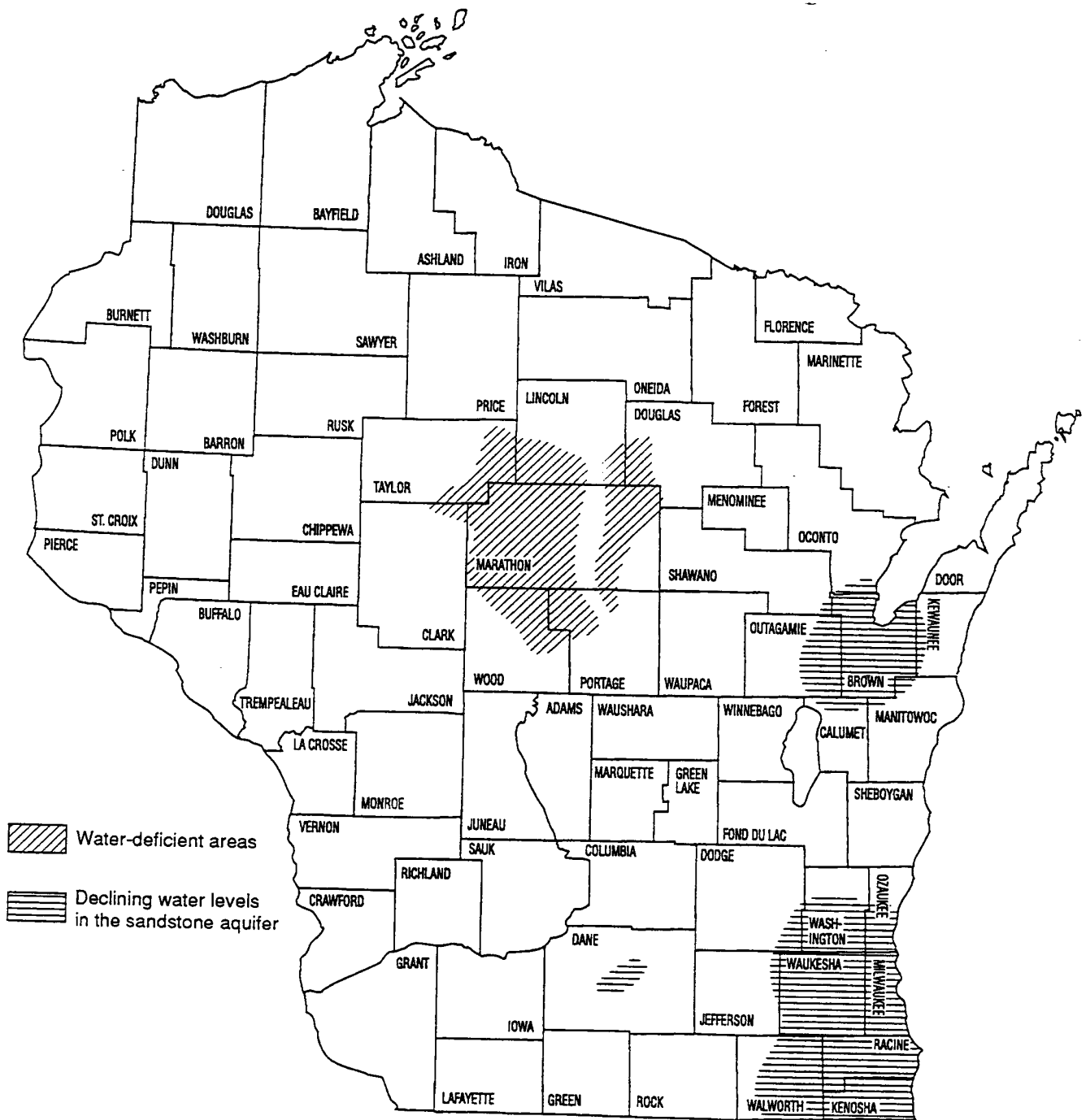


Figure 2. Map showing generalized areas of water-deficiency and declining water levels  
(Source: WGNHS files)



biennially. During 1994, systematic observations of water levels were made on 184 wells. The location of the WGNHS-USGS observation wells is shown in Figure 3. Currently, the observation network is being evaluated for efficiency. Geophysical logging and well testing are planned for 1994-95 to obtain adequate data on geologic units and their hydraulic parameters on observation wells with insufficient basic documentation.

In 1994 water levels in Wisconsin wells were above or at normal levels after extreme climatic conditions in 1988-89 (drought) and in 1993 (flooding), which had significant impacts on groundwater levels in the state: record low levels during 1989-91, and record high levels in 1993.

In 1992 the WGNHS, USGS, and Dane County Planning Commission began a cooperative study of the hydrogeology of Dane County to better understand groundwater/surface water relationships, and in particular, the effects of groundwater withdrawals on streams, lakes, and wetlands. A primary product of this study will be a new countywide numerical groundwater flow model, which should be completed in 1995. Once this model and the associated hydrogeologic data bases are in place, the WGNHS will be better able to assess such issues as production well siting, wellhead protection, effects of land-use changes, and groundwater recharge in Dane County. Results of the study will be applicable to similar areas in Wisconsin.

Historically, little research has focused on groundwater quantity. However, four projects are being funded in FY 96 through the joint solicitation process which will provide valuable information on this important issue. Projects by Byron Shaw (UWS) and Jim Krohelski (USGS) will study groundwater-surface water relationships in the Little Plover River Basin and the Lower Fox River Valley, respectively. Ken Potter (UWS) will investigate both groundwater recharge in the driftless area and the role of wetlands in groundwater-surface water relationships.





## COORDINATION OF GROUNDWATER MONITORING AND RESEARCH

Four state agencies have approximately \$825,000 available each year for groundwater-related monitoring or research. The sources of money and purposes of monitoring or research include:

1. DNR Management Practice Monitoring - The DNR has approximately \$350,000 available each year to support groundwater monitoring studies evaluating existing design and/or management practices associated with potential sources of groundwater contamination. The money has come from the Groundwater Account of the Environmental Fund (which is funded by various fees). The intent of these studies is to reduce the impacts of potential sources of contamination by changing the way land activities which may impact groundwater are conducted.
2. UWS Groundwater Research - \$300,000 is available annually for groundwater research administered by the University of Wisconsin System (UWS). The money is part of the base UWS budget.
3. DATCP Pesticide Research - Since 1989, DATCP has had approximately \$125,000 available annually through fees from pesticide manufacturers as a result of the pesticide law to fund research on pesticide issues of regulatory importance.
4. DILHR Private Sewage System Research - DILHR received an annual appropriation of \$50,000 from 1990 to 1993 to fund research on alternatives to current private sewage system technology. In 1994, when the appropriation expired, \$75,000 generated through plan review and licensing fees became available each year for research on private sewage systems.

The GCC provides consistency and coordination among the four state agencies in funding groundwater monitoring and research to meet state agency needs. In 1988, the GCC requested that the UWS create a Groundwater Research Advisory Council (GRAC) to establish a long-range groundwater research plan and develop a groundwater research decision item narrative (DIN) for inclusion in the University's biennial budget. The GRAC consists of university, state agency, and public representatives.

Based on discussions with the GCC, the GRAC prepared a groundwater research DIN for inclusion in the University's 1989-1991 biennial budget request. The GCC endorsed the DIN in 1988. The DIN was included in the governor's budget and was approved by the Legislature at a level of \$500,000 for the 1989-1991 biennium for groundwater research. This amount was increased to \$600,000 for the 1991-1993 biennial budget. Statutory language requires that there be agreement between the UWS and the GCC on the use of the UWS research funds before the funds can be released by the Department of Administration.

To expedite this agreement, a Memorandum of Understanding (MOU) was signed in 1989 by representatives of the GCC, the GRAC and the UWS on use of the UWS groundwater research funds. The MOU spells out the procedures for establishing priorities and selection of projects for funding of UW groundwater research. The MOU recognizes that the GCC has a substantive role in establishing research priorities and an advisory role in project selection to minimize overlap and duplication.

The UWS funded 19 groundwater research proposals during FY 90 and FY 91 with concurrence from the GCC. The results of the first studies that were funded by the UWS were published in October 1991 by the UW Water Resources Center in a report titled, "UWS Groundwater Research Program, Summary of 21 Projects".

During the summer of 1990, the GRAC and GCC developed and endorsed a plan to coordinate the solicitation of projects for funding in FY 92 and subsequent years. The joint solicitation provides for only one submittal of project proposals, rather than four as had been the case. The intent of the plan is to determine the most appropriate funding source for funding a particular project.

Summarization of agencies efforts promoted through the joint solicitation is as follows:

1. DNR - The DNR has been funding groundwater management practice monitoring projects since FY 86. Through FY 95, the DNR has spent approximately \$3.1 million on 120 monitoring projects. One project has been co-funded with DATCP.
2. UWS - The UWS has received funding since FY 90 for groundwater research. They received \$200,000 in FY 90 and \$300,000 annually since then. Through FY 95, the UWS has spent \$1.7 million on 46 groundwater research projects. Three of the 46 projects have been co-funded with DATCP.
3. DATCP - DATCP has received approximately \$125,000 per year since FY 90 for pesticide research. The money comes from fees paid by pesticide manufacturers to sell their products in Wisconsin. Through FY 95, DATCP has spent about \$750,000 on 13 pesticide projects. Three were co-funded with the UWS and 1 was co-funded with the DNR.
4. DILHR - DILHR received a special GPR appropriation of \$50,000 for 4 years s. 145.20(5), Stats., beginning with FY 90 to fund research on alternatives to current private sewage system technology. That appropriation ended at the end of FY 93. In 1994, \$75,000 generated through plan review and licensing fees became available each year for research on private sewage systems. Through FY 95, DILHR has spent \$337,600 on three projects.

Approximately \$5.9 million has been spent through FY 95 on 180 different projects dealing with groundwater or related topics.

#### FY 95 Monitoring Projects - Joint Solicitation

The joint solicitation for FY 95 was distributed in November, 1993. A total of 36 project proposals were submitted in response to the joint solicitation. To assist in the review process, a joint meeting of the Monitoring & Data Management and Research Subcommittees of the Groundwater Coordinating Council was held in early March 1994 to review and rank the projects submitted for funding. As a result of that meeting and review of the proposals by DNR staff, 8 new projects were selected for funding in FY 95; one of those is being co-funded with the DATCP. Five on-going projects were carried over into FY 95.

In addition to the projects funded by the DNR, the UW System fully funded 14 projects and co-funded one project with DATCP. DILHR fully funded one project in FY 95. A total of 34 projects were funded through the joint solicitation at a cost of approximately \$795,845 (see Table 1 and Figure 4).

#### FY 96 Monitoring Projects - Joint Solicitation

A joint solicitation for project proposals by the UW System, DNR, DATCP and DLR was distributed in November, 1994 for funding in FY 96. The deadline for proposals was January 17, 1995. The joint solicitation contains a listing of the priorities for each of the agencies (see appendix). The priority needs for the DNR's management practice monitoring program for FY 96 were identified by the Monitoring & Data Management and Research Subcommittees of the Groundwater Coordinating Council. The two subcommittees met in early March to rank the 40 proposals submitted. Seventeen of the 40 proposals received will be funded in full or in part through the joint solicitation process. The projects to be funded in FY 96 are listed in Table 2.

A survey has been distributed to investigators who have submitted proposals in the past two years to assess how the joint solicitation is working. The results of the survey will be used when preparing the FY 97 joint solicitation package.

**Table 1 - Groundwater Projects Funded Through  
the Joint Solicitation for FY 95**  
(Numbered projects are located on the State map in Figure 4)

Projects funded by the DNR in FY 95

1. \*Optimization of Two Recirculating Sand Filters for Nitrogen and Organic Chemical Removal from Domestic Wastewater. Byron Shaw. \$30,390.
2. \*Integrated Computerized Mapping of Point Source Contaminants and Physical Environmental Characteristics to Protect and Manage Groundwater Quality. Richard Stoll. \$27,940.
3. \*Long-term Transformation and Fate of Nitrogen with Mound type Soil Absorption Systems for Septic Tank Effluent. John Harkin. \$10,000.

Nitrate Sampling in Priority Watersheds. \$10,000.

4. Application of a Discrete Fracture Flow Model for Wellhead Protection at Sturgeon Bay, Wisconsin. Kenneth Bradbury and Maurgen Muldoon. \$43,155.

A Comparison of Low Flow Pumping and Bailing for VOC Sampling. Jack Connolly and Hank Kuehling. \$24,996.

5. An Evaluation of Long-term Trends and a Mineralogical Interpretation of Naturally Occurring Metals Contamination and Acidification of the St. Peter Sandstone Aquifer. Annette Weissbach. \$17,210.

6. Agrichemical Impacts to Groundwater Under Irrigated Vegetables in the Central Sand Plain. George Kraft and Larry Binning. \$27,500.

Characterization of *E. Coli* and Total Coliform Organisms Isolated from Wisconsin Groundwater and Reassessment of their Public Health Significance. Bill Sonzogni and Jon Standridge. \$7,600.

Collection of Hydraulic and Geologic Data to Improve the Quality of the Wisconsin Groundwater Monitoring Network. Alex Zaporozec. \$14,180.

7. Vertical and Horizontal Variability of Hydrogeologic Properties in Glaciated Landscapes. Dave Mickelson. \$26,250.

8. Direct and Residual Effects of Land-applied Sweet Corn Processing Wastes on Nitrate Loss to Groundwater. Larry Bundy. \$20,745.

9. \* Pesticides and Groundwater Impacts. Jeffrey Postle. \$11,731.

The total cost for projects funded by the DNR in FY 95 including the co-funded project below, is \$291,240.

Projects funded by the UWS in FY 95

- \* Photocatalytic Degradation of Volatile Organic Carbon. Marc Anderson. \$14,275.
- \* Improved Design of Pump and Treat Systems for Heterogeneous Aquifers Jean Bahr. \$22,935.
- \* Mineral Phase Sorption of Selected Agricultural Chemicals to Wisconsin Soils Tim Grundl. \$21,115.
- 10. \* Stratigraphy, Sedimentology, and Porosity Distribution of the Silurian Rocks of the Door Peninsula, Wisconsin. Mark Harris. \$20,755.
- 11. \* Using 'PREDICT' to Reduce Herbicide Usage and Improve Groundwater Quality. Robert Gordon Harvey. \$15,800.
- \* Comparative Evaluation of Biostimulation Approaches for Enhancing *in situ* TCE Degradation in Contaminated Aquifers. William Hickz. \$23,835.
- 12. Tracer Study for Characterization of Groundwater Movement and Contaminant Transport in Fractured Dolomite. Ken Bradbury. \$19,000.
- Evaluating the Effectiveness of Landfill Liners. Craig Benson. \$23,890.
- 13. Geologic Constraints on Arsenic in Groundwater with Applications to Groundwater Modeling. Juan Simo. \$26,255.
- 14. Integration of Hydraulics and Geology into a Hydrostratigraphic Model for the Paleozoic Aquifer of Eastern Dane County, Wisconsin. Douglas Cherkauer. \$21,185.
- Use of Heavy Nitrogen to Study Nitrate Flux from Septic Systems. John Harkin. \$21,725.
- 15. Development and Demonstration of an Accurate Manure Spreading System to Protect Water Quality, Improve Waste Management and Farm Profitability. Kevin Shinnars. \$21,155.
- Evaluation of Enzyme-linked Immunosorbent Assay for Herbicide Analysis of Wisconsin Soil in Comparison to Gas Chromatography. William Sonzogni. \$9,300.
- Synergistic Effects of Endocrine Disrupters in Drinking Water. Warren Porter. \$21,900.

The total cost for projects funded by UWS in FY 95, including the co-funded project below is \$295,125.

#### Projects funded by DATCP in FY 95

- 16. Leaching Potential of Imazethapyr and Nicosulfuron Herbicides in Sparta Sand. Birl Lowery. \$18,680.
- 17. Cover Crops to Limit Herbicide Use on Sweet Corn. Astrid Newenhouse. \$24,000.
- 18. The Use of Peat as an Adsorptive Medium for Remediation of Pesticide Contaminated Groundwater. James Wiersma. \$14,300.

A Low-Input Crop Management Plan for Wisconsin Fresh-Market Vegetable Growers. Karen Delahaut. \$3,000.

The cost for projects funded by DATCP was \$124,980, including the co-funded project listed below.

Project co-funded by DATCP and DNR in FY 95

19. Groundwater Hydrology of an Agricultural Watershed. Kenneth Potter. Carl Bowser and Kenneth Bradbury. \$29,543 DNR, \$20,000 DATCP.

Project co-funded by DATCP and UWS in FY 95

20. Herbicide Contamination of Soil and Groundwater at a Mixing/Loading Site. Gordon Chesters. \$12,000 UWS, \$45,000 DATCP.

Project funded by DILHR in FY 95

21. Nitrogen Removal from Domestic Wastewater in Unsewered Areas. Richard Otis, James Converse, et. al. \$74,500.

Projects preceded by an asterisk are projects which were also funded in FY 94.

Figure 4 - Location of groundwater monitoring or research projects in FY 95  
(Refer to Table 1 for project numbers and descriptions)



**Table 2 - Groundwater Projects to be Funded Through  
the Joint Solicitation for FY 96**

Continuing projects to be funded by DNR in FY 96

An Evaluation of Long-term Trends and a Mineralogical Interpretation of Naturally Occurring Metals Contamination and Acidification of the St. Peter Sandstone Aquifer. Annette Weissbach. \$20,000.

Agrichemical Impacts to Groundwater Under Irrigated Vegetables in the Central Sand Plain. George Kraft and Larry Binning. \$51,243.

Collection of Hydraulic and Geologic Data to Improve the Quality of the Wisconsin Groundwater Monitoring Network. Alex Zaporozec. \$9,450.

Pesticides and Groundwater Impacts. Jeffrey Postle. \$4,504.

Direct and Residual Effects of Land-applied Sweet Corn Processing Wastes on Nitrate Loss to Groundwater. Larry Bundy. \$19,430.

The cost for continuing projects to be funded by DNR in FY 96 is \$104,627.

New projects to be funded by DNR in FY 96

Application of a Discrete Fracture Flow Model for Wellhead Protection at Sturgeon Bay, Wisconsin. Kenneth Bradbury and Maurzen Muldoon. \$33,823.

Optimum Management of Ground-water Resources in the Lower Fox River Valley. James Krohelski. \$34,375.

Variability of Nitrate Loading and Determination of Monitoring Frequency for a Shallow Sandy Aquifer, Arena, Wisconsin. Fred Madison. \$13,126.

An Investigation of VOC Sampling Techniques at Slowly Recovering Monitoring Wells. Jack Connolly. \$24,690.

GIS as a Tool to Prioritize Environmental Releases, Integrate their Management, and Alleviate their Public Threat. Richard Stoll. \$27,940.

Delineation of Capture Zones for Municipal Wells in Dane County, Wisconsin. Kenneth Bradbury. \$22,747.

The cost for new projects funded by the DNR in FY 96 including the co-funded project below is \$168,631.

The total cost for all projects funded by the DNR through the joint solicitation process in FY 96 is \$273,258.

Continuing projects to be funded by the UWS in FY 96

Tracer Study for Characterization of Groundwater Movement and Contaminant Transport in Fractured Dolomite. Ken Bradbury. \$16,764.

Evaluating the Effectiveness of Landfill Liners. Craig Benson. \$24,480.

Integration of Hydraulics and Geology into a Hydrostratigraphic Model for the Paleozoic Aquifer of Eastern Dane County, Wisconsin. Douglas Cherkauer. \$25,080.

Development and Demonstration of an Accurate Manure Spreading System to Protect Water Quality, Improve Waste Management and Farm Profitability. Kevin Shinnars. \$25,860.

Synergistic Effects of Endocrine Disruptors in Drinking Water. Warren Porter. \$24,703.

The cost for continuing projects to be funded by UWS in FY 96 is \$116,887.

New projects to be funded by the UWS in FY 96

Responses of Biological Toxicity Tests to Mixtures of Pesticides and Metabolites. Gordon Chesters. \$29,970.

The Use of Azimuthal Resistivity & Self Potential Measurements to Delineate Groundwater Flow Direction in Fractured Media. Robert Taylor. \$21,678.

Stratigraphic Controls on the Mobilization and Transport of Naturally Occurring Arsenic in Groundwater: Implication for Wellhead Protection in Northeastern Wisconsin. Juan Simo. \$24,980.

Characterization of the Role of Evapotranspiration on Groundwater Movement and Solute Chemistry in Groundwater-fed Wetlands. Kenneth Potter. \$20,025.

Bioremediation of Hydrocarbons Influenced by Air Sparging: A Multi-model Approach to Assess Contaminant Mass Removal. Jean Bahr. \$19,470.

Biostimulation of Trichloroethylene Degradation in Contaminated Aquifers. William Hickey. \$20,320.

Evaluation of Well Seals Using an Ultrasonic Probe. Tuncer Edil. \$24,740.

The total cost for all projects funded by the UWS in FY 96, including the co-funded project below is \$173,113.

Project to be co-funded by DNR and UWS in FY 96

Evaluation of Shallow-soil Absorption Fields Associated with Advanced On-site Disposal System. Ronald Stieglitz. \$11,930/\$11,930.

Projects to be funded by DATCP in FY 96

An Integrated Approach to the Management of Insects in Sweet Corn Grown for Fresh Market. John Wedberg. \$16,000.

Land Use Effects on Groundwater and Streamwater Quality in the Little Plover River Watershed. Byron Shaw. \$33,930.

Iron-based Abiotic Destruction of Chlorinated Solvents and Pesticides in Groundwater. Gerald Cykholt. \$24,950.

Ground-water Recharge and Contamination in Wisconsin's Driftless Area. Kenneth Potter. \$30,000.

The total cost for all projects funded by DATCP in FY 96 \$104,880.

Projects to be funded by DLR in FY 96

Nitrogen Removal from Domestic Wastewater in Unsewered Areas. Ayres & Assoc. \$52,775.

Use of Heavy Nitrogen to Study Nitrate Flux from Septic Systems. John Harkin. \$21,725.

The total cost for all projects funded by DLR in FY 96 \$74,500.

## BENEFITS FROM MONITORING AND RESEARCH PROJECTS

Table 3 (see Appendix) is a list of groundwater-related monitoring and research projects funded by state agencies since enactment of Wisconsin's comprehensive groundwater protection legislation (1983 Wisconsin Act 410) in 1984. Those agencies which have funded projects are the DNR, DATCP, DILHR and the UWS. There are 178 projects listed. Eighty-three of these projects have been funded through the joint solicitation process which began in FY 92. The remaining projects were funded by the above agencies through separate solicitation processes prior to 1992. The table includes the project title, principal investigator or investigators, the years the project was funded and the funding agency or agencies.

Many projects have provided valuable information to evaluate existing regulatory programs and determine if there is a need for additional regulations. Numerous studies have increased the knowledge of the movement of contaminants in the subsurface. A number have provided valuable information regarding the state's groundwater resources. Others have developed new methods for groundwater evaluation and protection. The following discussion highlights some of the areas that have been the focus of research and monitoring projects and illustrates how agencies have used the project's results to improve the management of the state's groundwater resources.

The Atrazine Rule - The development of the Atrazine Rule (ATCP 30, Wis. Adm. Code) illustrates how the benefits of state-funded research and monitoring can build on one another. In the mid-1980s the corn herbicide atrazine began to be detected in monitoring wells and private drinking water wells in Wisconsin. The first systematic well sampling program to characterize atrazine contamination on a statewide basis was the 1988 DATCP Grade A Dairy Farm Well Water Quality Survey (LeMasters, 1989). This state-funded well survey estimated that atrazine was present in 12% of the Grade A Dairy Farm Wells in the State.

This study left many questions regarding the sources, groundwater susceptibility and the presence of pesticides other than atrazine unanswered. Without better information on these and other questions, it was challenging for DATCP, the agency charged with groundwater protection related to agricultural chemicals, to develop a plan of action. It was obvious that a concerted information gathering program was needed. Over the next several years, before and during the development of the DATCP atrazine rule, the Wisconsin Groundwater and Pesticide Research program played an essential role in providing the needed information. Research and monitoring were conducted on several topics that played a direct role in the evolution of the atrazine rule.

The state research and monitoring program funded several key projects to better understand the sources of atrazine contamination. When atrazine was first found in groundwater, an argument had been made that this was the result of point sources such as spills and mishandling. One of the most important findings that allowed DATCP to begin developing the atrazine rule was that normal agricultural applications of atrazine could lead to groundwater contamination. The DATCP groundwater monitoring project (Postle, 1986-94) for pesticides used monitoring wells located next to agricultural fields to study groundwater contamination by atrazine and other pesticides. This study showed that atrazine from field use on sandy soils could cause contamination, often above the CS 3 µg/l. The UW Water Resources Center conducted a detailed hydrogeologic study (Chesters, 1990-91) at a farm in Dane County and showed conclusively that atrazine contamination could result from both field applications and mixing/loading practices. With the knowledge that nonpoint contamination of groundwater by atrazine was indeed occurring, DATCP could develop ways to reduce this contamination.

State-funded research was essential in showing that atrazine contamination did not follow simplistic notions of groundwater contamination susceptibility. One of the most important findings was that the Central Sands and the Lower Wisconsin River Valley (LWRV), two areas that appear similar in soils and agricultural practices, had significantly different susceptibility to contamination. These differences were pointed out in several research projects conducted by the UW Soil Science Department (Daniel, 1991; Lowery, 1991; McSwiney, 1991; Lowery, 1992-3). This information had a direct influence on the atrazine rule in that there is now a use prohibition in the LWRV and managed use in the Central Sands.

Another key finding related to the susceptibility of groundwater to atrazine contamination was that many of the areas with high frequency of detections had medium textured (loamy) soils. It had previously been thought that these areas were less susceptible to leaching and groundwater contamination than areas with sandy soils. State-funded research and monitoring efforts, however, showed that the intensity of atrazine use, in addition to soil and geologic conditions, played an important role in the contamination. This finding helped to explain why many areas in south central Wisconsin, with medium textured soil and high corn production, had many wells contaminated with atrazine. This knowledge allowed DNTCP to adopt management strategies for reducing atrazine contamination in these areas.

When atrazine was first discovered in Wisconsin's groundwater in the mid 1980s, DNTCP was interested in managing its use based on predictive modelling of contamination processes. Modelling activities funded by the state research program, however, indicated that the behavior of atrazine and other contaminants in the environment was complex and could not be reliably predicted by modelling. In response to this finding, DNTCP adopted a more empirical approach to identifying management areas. Actual well results were plotted on maps and, together with an analysis of soils and geology, management areas were delineated.

When monitoring and rule making efforts for atrazine first started, parent atrazine was the only compound that was considered. As more research was conducted, however, it was discovered that three metabolites (breakdown products) of atrazine were present in groundwater and were of health concern (Chesters, 1990-91; LeMasters, 1990; Cowell, 1990; Catcs, 1991). State-funded sampling programs showed that due to the presence of atrazine metabolites, the groundwater problems were more serious than previously considered. This knowledge allowed DNR to strengthen the groundwater standard for atrazine in 1992 and allowed DNTCP to strengthen the atrazine rule in 1993 and extend required use reductions to the entire state.

It is interesting to try to envision how DNTCP's atrazine rule would look if it did not have the benefit of the intensive research and monitoring efforts. It is safe to say that it would not have been developed on as good an understanding of the behavior of atrazine in the environment or the geographic patterns of contamination. It is possible that without the intensive monitoring efforts, the full extent of the problem would not have been discovered and atrazine use would not have been reduced. On the other hand, it is possible that with inadequate knowledge a "broad brush" approach would have been taken. This could have resulted in unfair regulations that were not tailored to the different geographic areas of the state.

Two important aspects of environmental regulations that promote its acceptance are that it is based on science and that it is fair. Good research is necessary to achieve these two characteristics. The Atrazine Rule has experienced a relatively high degree of acceptance due to the effort that was put into its development.

Groundwater Monitoring at Solid Waste Disposal Sites - The DNR's Bureau of Solid and Hazardous Waste Management (SHWM) has received project funding seven times from 1985 to 1994 through the joint solicitation process. These projects have benefited the DNR's Solid Waste Management program in many ways, primarily, impacting regulations and monitoring practices.

The first two studies (Friedman, 1985-87; Battista, 1988-89) revealed for the first time that groundwater around many Wisconsin landfills was contaminated by VOCs. The studies also showed that VOC contamination of groundwater was more common at unengineered municipal solid waste landfills than at other types of landfills. A follow-up VOC study (Connelly 1993-94) showed that VOC levels have decreased at most of the unengineered landfills though at many of the sites VOC levels do not show continued decline. There was no VOC contamination definitely attributable to leachate migration at any of the older, engineered landfills which confirmed that these sites are performing as SHWM staff had hoped. The results of the three VOC studies have been used to establish requirements for VOC sampling at new and existing landfills. These studies have also indicated that inorganic compounds could be useful in predicting VOC contamination at landfills. Therefore, until recent EPA rules required VOC monitoring, the SHWM allowed sites to sample for inorganic parameters as part of routine monitoring and not sample VOCs until inorganics were elevated. The VOC studies provided valuable data which was used to convince EPA to reduce the number of VOCs required for monitoring at municipal solid waste landfills in Wisconsin. This reduction in monitoring (the use of inorganics and the reduced number of VOCs when they are required) allowed landfill owners considerable savings while providing equivalent environmental protection. Additionally, the VOC data was used to require responsible parties to define the degree and extent of contamination and remediate groundwater contamination at their landfills.

Research on methods of assessing groundwater quality data and data quality control completed in the third VOC study has been helpful to SHWM staff and consultants in interpreting groundwater quality data from landfills and other facilities. This study also showed the need to require laboratories to report data between the limit of detection and the limit of quantitation.

An assessment of Wisconsin's Groundwater Monitoring Plan program (Pugh, 1992) for active non-approved landfills provided the documentation of a set procedure for selecting monitoring sites. This information has been useful in recent meetings with municipalities held to convince municipalities that they have not been singled out for further evaluation of groundwater contamination and to demonstrate that the process used for selecting landfills for monitoring is objective.

Three studies from 1991 to 1994 on the potential groundwater impacts at deer pits, yard waste sites, and construction and demolition landfills (Pugh, 1992-3; Pugh, 1994) were conducted because little or no data existed on the potential impact to groundwater from these sites. Research has provided the information necessary to establish policy regarding monitoring and siting of demolition landfills, deer pits, and yard waste sites in Wisconsin. The groundwater study of deer pits showed that impacts were minimal and helped the SHWM to decide not to require liners and to loosen some construction and reporting requirements. Similarly, the yard waste site study showed only minor groundwater impacts which led the SHWM to encourage active management of these sites rather than stiffen regulations. The study of construction and demolition landfills showed some groundwater impacts at large sites but little or no impacts at smaller sites. These findings led to new proposed regulations allowing an intermediate size demolition landfill which would have the economic benefits of a large site without the potential

negative impacts of very large sites. Since these studies have been conducted, many states and the EPA have contacted the SHWM about the information collected.

A recent DNR-funded study undertaken by the SHWM (Connelly, 1994) was a comparison of groundwater sampling methods for collecting metals samples at monitoring wells. The study was in response to EPA's October 1991 ban on field filtering of groundwater samples which became effective in October 1994. The SHWM opposed this ban because many Wisconsin monitoring wells produce very turbid water which can lead to false positive results for metals if samples are not filtered. Additionally, the new EPA-recommended procedure, low-flow pumping, requires a significant amount of additional equipment. The study showed that the low-flow pumping method was appropriate in many circumstances but could not be used to sample slowly recovering wells. The results showed that turbidity was the best indicator that a well has been sufficiently purged. The results of the investigation are being used to revise groundwater sampling procedures required by the SHWM. Additionally, the study helped establish Wisconsin as one of two leading states playing a major role in advising EPA on revisions to their groundwater sampling requirements at municipal solid waste landfills.

Monitoring for Naturally Occurring Compounds - Wisconsin is also a leader in groundwater monitoring for naturally occurring compounds. Two projects in the DNR Lake Michigan District (Stoll, 1992; 1994) identified the existence of lead and arsenic contamination in groundwater. Homeowners were alerted through direct mailings, public meetings and mass media news releases. Over 72,000 people were unaware of their exposure to the substances in their drinking water. The sources of metals in these drinking water supplies were either given priority for removal (Door County Lead Arsenate Mixing Sites) or well construction criteria were defined to avoid arsenic associated with the St. Peters Sandstone. The DNR coordinated with the DHS to conduct health surveys on individuals consuming locally contaminated water supplies and made appropriate health recommendations. Research is continuing in this area.

Groundwater Movement in Fractured Dolomite - Door County has been the site of three research projects by the WGNHS to develop a framework for studying the complex groundwater flow regime in fractured rock found in many parts of the state. The first project (Bradbury, 1986-90) started as a non-point source watershed project investigating the hydrogeology and groundwater geochemistry in the shallow fractured dolomite aquifer in Door County. Groundwater quality was found to vary widely over time with bacteriological contamination common. The second study (Bradbury, 1992) showed that modeling results obtained from a discrete fracture model varied considerably from results produced by a continuum model for groundwater movement. The discrete fracture model estimated capture zones, groundwater flow paths and groundwater travel times by using mathematical representations of fractures digitized from aerial photos. The third study (Bradbury, 1993-94) used a tracer for characterization of groundwater movement and contaminant transport. It revealed that hydraulic conductivity can vary widely in the same well depending on what depth interval is tested. A fourth study is currently applying a discrete fracture flow model for wellhead protection at Sturgeon Bay.

Developing New Tools for Groundwater Protection - Applications of a wide variety of tools for gathering and working with hydrogeologic and groundwater quality data have been funded. Projects involving one of the most promising tools in environmental management, Geographic Information Systems (GIS) have been funded in the Lake Michigan District and in Dane County. The funding agencies hope to continue to develop improved methodologies to make groundwater quality and contaminant source data more readily available.

An environmental inventory utilizing GIS was created in the DNR's Lake Michigan District (Carlson, 1992-93; Stoll, 1994). Computerized maps were created which link all potential groundwater impact site locations with their respective data. This project has resulted in numerous map products showing potential groundwater contamination source/receptor relationships in a rapidly retrievable, highly summarized fashion. Many consultants, county agencies, state agencies and realtors have utilized this information for environmental management and land transactions. The chief benefits to the public have been the rapidly accessible information and greater purchasing confidence when buying property. Landowners also experience increased responsibility for the land they reside on as they become aware of how readily available this information is. In this way, use of GIS has heightened awareness of the importance of wise land use.

Prevention and Remediation of Groundwater Contamination - Twelve research projects emphasizing new technologies for prevention or remediation of groundwater contamination have been supported by the State of Wisconsin through the UWS Water Resources Center. Several of these projects have been completed. Final technical reports are published or in press. The reports provide information or products which will be important for future efforts aimed at controlling or attenuating groundwater contamination in Wisconsin. The findings cover a wide range of technologies including:

- New and enhanced physicochemical or biological methods to renovate waters contaminated by pesticides and volatile organic carbon compounds (Anderson, 1994-95) (Chesters and Harkin, 1991) (Harris and Hickey, 1991-92);
- Enhancements in the ability to control, monitor, and predict the movement of landfill contaminants to groundwater (Edil and Park, 1992-93) (Benson, 1995-96);
- Improvements in the predictability of pump-and-treat remediation applications to contaminated aquifers (Bahr, 1994-95);
- Innovative agricultural practices designed to reduce groundwater contamination by pesticides and nitrate (Bundy, 1993-94) (Bahr, 1991-92) (Harrison, 1992-93) (Newenhouse, 1995); and
- A promising yet untested technology to isolate radium in groundwater by coprecipitation with iron and manganese where they are present in sufficient abundance (Cherkauer, 1991-92).

Effects of Groundwater Contamination on Real Estate Values - G. William Page and Harvey Rabinowitz of the University of Wisconsin-Milwaukee School of Architecture and Urban Planning studied the effects of groundwater contamination on commercial and residential property values. Their report affirms that real estate value exists in the perception of prospective buyers and sellers and that groundwater contamination adversely affects the value of real estate. The value of such real estate is reduced to its "value in use" rather than its market value. Thus, it is frequently impossible to sell such real estate or even to use it as collateral for a loan because, in the case of a default, the lending institution would not be interested in taking the property through foreclosure for fear of liability. They find that the fear of groundwater contamination is so pervasive that even local governments are beginning to shy away from taking selected buildings *in lieu* of taxes owed. For example, the City and County of Milwaukee holds off for approximately 3 years, while charging interest, before initiating proceedings to take a property *in lieu* of those taxes. The City's recent experiences with several groundwater contaminated properties in which the clean-up costs exceeded the normal market value of the property by a factor of 10 to 20 has required a policy change. Many of these kinds of properties are now left abandoned across the United States and municipalities are reluctant to fence in or manage the properties because they may lead to liability as has been determined in several court cases in different states. Thus their "use value" is characterized by negative impacts on property tax bases which often extends to the



neighborhoods where the contaminated properties are located. The report covers Federal and State and Local Government Regulations of contaminated properties and regulation by the marketplace which includes owners, lessors, financial institutions, secondary mortgage companies, appraisers, insurance companies (title, property, and liability), law firms, and real estate brokers.

Biological Effects of Groundwater Contaminants - At the urging of the Wisconsin Groundwater Research Advisory Council (GRAC), the UW-Water Resources Center has solicited research projects during the last biennium that deal with biological effects of groundwater contaminants. Two of 3 such projects have been selected for funding and both are still active. They deal with cooperative biological effects among chemical contaminants; this is a subject of widespread current interest because synergistic interactions among chemical contaminants can often greatly enhance or diminish the toxicity of individual components of a mixture. Warren Porter of the UW-Madison Department of Zoology is evaluating interactions between endocrine disruptors (PCBs, phthalates, etc.) and a common groundwater contaminant (nitrate). Gordon Chesters, George Blondin, and Harry Read of the UW-Madison Water Resources Center have initiated a project that will focus on interactions between herbicides and nitrate. There is a great deal of current interest in these types of interactions because environmental toxicologists have focused exclusively on evaluations of individual chemicals in biological systems.

## GROUNDWATER DATA MANAGEMENT

### WISCONSIN DEPARTMENT OF NATURAL RESOURCES

The collection and coordination of groundwater data exchange within the DNR and with outside agencies continues to be an important issue. The DNR places priority on coordinating the collection and retrieval of all groundwater data to meet inter-agency responsibilities and cooperative agreements.

The DNR groundwater data retrieval system, the Groundwater Retrieval Network (GRN), was completed in October 1993. Enhancements to the system, suggested by District and Central office staff, are implemented annually, to improve system functionality and ease of use. The current GRN system has links to the Public and Private Water Supply and Water Resources program data systems for retrieval. The Solid and Hazardous Waste Groundwater and Environmental Monitoring system (GEMs) is in the final stages of development and implementation. The Wastewater program data systems will be made accessible to the retrieval network when the redesign of this program system is completed; the redesign has not been scheduled.

The GRN system includes a mechanism for creating and updating a statewide GIS coverage of well locations. Through a new option recently added to the GRN download menu, users can extract data in a format used by ARCVIEW 2 (a desktop GIS viewing software package produced by the makers of ARC/INFO). A customized ARCVIEW 2 application has also been developed that automatically loads the data downloaded from GRN and creates a well GIS "layer" for viewing and querying purposes. Data can also be provided in other GIS formats upon request through the use of ARC/INFO.

To provide access to the system for other state agencies, computer hardware and software was provided to DATCP, DILHR, and DHS, WGNHS and the Central Wisconsin Groundwater Center. Documentation and training was recently provided for using the new GRN system. The sharing and exchange of information between agencies dealing with groundwater is enhanced by the GRN system.

### DEPARTMENT OF AGRICULTURE, TRADE AND CONSUMER PROTECTION

DATCP needs up-to-date, reliable data on pesticide contamination of groundwater. These data are used to develop substance specific rules on pesticide use, such as DATCP's "Atrazine Rule" (Chapter ATCP 30, Wis. Adm. Code), to respond to citizen requests on groundwater quality data for specific locations, and to initiate timely investigations of pesticide contamination of groundwater. DATCP ensures the quality of its database by carefully checking and cross-referencing manual (e.g., paper lab slips) and computerized data received from DNR and other sources. DATCP feels that this is necessary because the data are used for regulatory purposes.

The DATCP groundwater database currently contains locational information for over 13,000 wells and over 22,000 sample analysis results. These data represent samples analyzed by DATCP, the State Laboratory of Hygiene, and other public and private laboratories. The groundwater database operates in a multiuser environment under Paradox 4.0. All members of the groundwater unit access the database via Pathworks operating on the DATCP's VAX computer. Links between the groundwater sample database and DATCP's pesticide case tracking system are also being developed.

DATCP uses GIS tools to analyze groundwater data and prepare maps for public hearings and other uses. For example, an ARC/INFO data layer containing well locations and associated database information is being used to generate maps of atrazine and other pesticide detections statewide for the Atrazine Rule. Other GIS analyses involve identifying groundwater wells that may be impacted by point sources of pesticide and nitrate.

## WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY

The University of Wisconsin-Extension Geological and Natural History Survey has responsibility for geologic mapping, collection and analysis of basic data, and survey and research on Wisconsin's groundwater resources. Products from the Survey geologic mapping program support land-use planning and groundwater quality management and protection. County-wide inventories of groundwater resources are supported through cooperative agreements with county governments. Through analysis and integration of data from subsurface records and water quality sampling programs, these studies develop water table elevation maps and other products, providing planners and educators with a good foundation of information for groundwater quality management and protection. Detailed research and monitoring of groundwater movement and quality are undertaken on a project basis. Maps, publications, and presentations are developed for groundwater education and outreach.

Computerized groundwater databases have generally been developed on a project basis to support on-going research and inventory efforts. Many of these data have been incorporated into the ARC/INFO geographic information system. The Survey is continuing initiatives to better integrate their data holdings, which are currently on a variety of personal computers, media and software systems. This effort will improve access and use of our existing and future groundwater and geologic data.

## DEPARTMENT OF INDUSTRY, LABOR AND HUMAN RELATIONS

DILHR has embarked on an information technology initiative, the purpose of which is data integration. With regard to groundwater protection, DILHR will, at the completion of this project, be able to identify sites that have underground petroleum storage tanks and private sewage systems. Sanitary permits, groundwater monitoring data, and underground storage tank information will be located in combined databases, the result will be groundwater quality data and information on activities that may affect groundwater quality.

## DEPARTMENT OF HEALTH AND SOCIAL SERVICES

DHSS does not maintain a centralized database on groundwater data. The Department relies on other state agencies for computerized groundwater information. DHSS maintains lab/slip samples data in project specific files.

## UNIVERSITY OF WISCONSIN SYSTEM

The Central Wisconsin Groundwater Center maintains a database of private well testing data from the Environmental Task Force Regional Laboratory at UW-Stevens Point, and Drinking Water Education Programs conducted through the Center. There are currently over 176,000 individual test results for approximately 28,900 samples covering the entire state. Chemistry data includes pH, conductivity, alkalinity, total hardness, nitrate-nitrite, chloride, saturation index and coliform bacteria. The database primarily covers the period 1985 to the present. The database is PC based and can be easily queried to be a significant source of information for local communities and groundwater managers. Thirty-two counties are represented by 100 or more samples in the databases, and 14 counties are represented by 500 or more samples.

#### DEPARTMENT OF TRANSPORTATION

The DOT maintains records of hazardous materials (hazmat) investigations associated with highway projects. Records of hazardous materials encountered during these investigations, including any groundwater contamination, are on file in the Hazardous Materials section of the Office of Environmental Analysis.

Groundwater monitoring is conducted in association with several DOT wetland mitigation projects. The records of this monitoring effort contain information on groundwater elevation and horizontal and vertical groundwater gradients as it relates to a wetland restoration or creation project.

The DOT is currently evaluating databases to incorporate information from wetland delineations, hazmat sites and groundwater monitoring sites into a geographical information system (GIS). GIS mapping is used for transportation planning, design, construction and maintenance.

## COORDINATION ACTIVITIES

### GROUNDWATER COORDINATING COUNCIL

The Groundwater Law, 1983 Wisconsin Act 410, established the Wisconsin Groundwater Coordinating Council (GCC) to advise and assist state agencies in coordinating nonregulatory programs and exchanging groundwater information. The GCC consists of the heads of all state agencies with some responsibility for groundwater management plus a Governor's representative. The agency heads have appointed high-level administrators who have groundwater responsibilities to sit on the Council. The state agencies include the DNR, DILHR, DHS, DATCP, DOT, WGNHS, and the UWS. Additionally the DNR has one permanent position with half of its responsibilities related to coordination of the GCC. The GCC had four meetings during the past year and met once via teleconference. The meeting minutes are included in the appendix.

The focus of the GCC's activities during the past year changed as past goals were attained and future goals were refined. Accomplishments came as a response to new opportunities for groundwater management.

- \*The GCC approved the 1996 fiscal year joint solicitation package for groundwater research and monitoring to meet state needs described in the previous section. The package was sent out in November 1994 and is contained in the appendix. On April 24, 1995 the GCC met by teleconference and unanimously approved the proposed UWS groundwater research plan. The UWS will fund 5 continuing and 7 new projects in fiscal year 1996 (see Table 2).
- \*The U.S. EPA endorsed Wisconsin's Comprehensive State Groundwater Protection Program (CSGWPP) as a core program. The GCC had reviewed and approved the plan in FY 94. The Vision Statement is included in the Appendix. Wisconsin was one of the first four states endorsed nationally for their CSGWPP. This endorsement once again sets Wisconsin ahead as a national leader. The EPA recognizes the importance of the GCC in coordinating cohesive groundwater management and regards the existence of the GCC as one of the strongest aspects of Wisconsin's groundwater program.
- \*The GCC coordinated efforts to distribute the findings of groundwater monitoring and research funded through the joint solicitation process. DNR and UW Water Resources Center (WRC) staff wrote summaries of 45 final reports in FY 95. Summaries of 65 reports will be published together in early FY 96. The DNR and WRC have nearly eliminated the backlog of final reports for which summaries have not been prepared. Copies of all final reports and summaries will be distributed by the WRC. DNR staff constructed a database for tracking research/monitoring project status. Plans were made to make the summaries accessible by computer through the National Library System and WisInfo online services.
- \*The GCC played a key role in resolving agency differences in producing the joint DNR-DHS "Nitrate in Drinking Water" brochure. The issue emphasized the importance of the GCC's Education Subcommittee in facilitating a consistent message. Work on the brochure made it apparent that research needs to be done on the health effects of nitrate. Consequently, a research priority regarding these effects was included in the joint solicitation package sent out in November that resulted in several research proposals on the topic.

\*The GCC reviewed and endorsed both the DNR Bureau of Water Supply's new "Radon in Drinking Water" brochure and the GCC's revised Groundwater Education Resource Directory.

\*The GCC continued to promote communication, coordination, and cooperation between the state agencies through its quarterly meetings. The GCC received briefings on:

- Subcommittee activities (see below);
- Groundwater Quantity;
- Comprehensive State Groundwater Protection Plan;
- ILHR 83;
- DNTCP Groundwater Monitoring for Pesticides;
- Herbicide and Nitrate Movement in Sandy Soil in the Lower Wisconsin River Valley;
- GIS Surface Water Integration;
- Utilizing GIS for Groundwater Management in the Lake Michigan District;
- Pesticide State Management Plan;
- Urban Stormwater Infiltration: Assessment and Enhancement of Pollutant Removal;
- DNTCP Atrazine and Alachlor Surveys and Nitrate Initiative;
- MTBE concerns in Southeast Wisconsin;
- Groundwater Monitoring at Solid Waste Disposal Sites.

\*The GCC directed the preparation of a report on groundwater quantity. The DNR took the lead in establishing a technical advisory committee and gathering information. A draft report is now being prepared which will summarize available information on groundwater quantity and consider options for managing problems which are identified (see also "Condition of the Resource: Groundwater Quantity"). The DNR added a groundwater quantity research priority to the 1996 joint solicitation package. Several related proposals were received, including four which were chosen for funding.

\*The GCC continued to maintain a dialogue on groundwater issues with federal agencies. Representatives from the Natural Resources Conservation Service (NRCS), Agricultural Stabilization and Conservation Service (ASCS) and the U. S. Geological Survey (USGS) have attended Council meetings and are *ex officio* subcommittee members.

## SUBCOMMITTEE ACTIVITY SUMMARIES

Research Subcommittee - The Research Subcommittee reviewed the priorities for the DNR's groundwater management practice monitoring program for FY 95. The revised priorities were included in the joint solicitation distributed by the UWS, DNR, DILHR and DNTCP in November, 1994.

The Subcommittee met with the Monitoring and Data Management Subcommittee in early March to review the 40 proposals which had been received as a result of the joint solicitation. Subcommittee members made recommendations which were used by the three agencies and the UWS in deciding which groundwater-related proposals to fund for fiscal year 1996. The projects to be funded in FY 96 are listed in Table 2.

At the request of the GCC, the Research Subcommittee met in May to address the accountability of the research/monitoring programs coordinated through the joint solicitation process. The subcommittee reviewed progress made on a draft document containing approximately 70 summaries of research/monitoring projects funded through FY 94, which will be published in late

1995. The subcommittee discussed distributing the summaries and final reports through the Water Resources Reference Services recent acquisitions list, WISCIINFO, and the DNR's environmental consultant list. The subcommittee also evaluated a DNR database constructed to track research/monitoring projects.

The subcommittee worked on ways to document the utility of research and monitoring funded through the joint solicitation process. Three types of benefits were identified: 1) Institutional changes (e.g. changes in regulations or practices); 2) Resource changes (e.g. changes in groundwater quality); and 3) Constituency satisfaction (e.g. satisfaction of state agencies). The subcommittee and DNR staff have documented the utility of research in the "Benefits from Monitoring and Research Projects" section of this report. In FY 96 the subcommittee will continue to make sure that the projects funded provide a useful benefit.

At the May meeting, the subcommittee also prepared a list of improvements for the 1997 joint solicitation package and developed a survey to evaluate the joint solicitation process that was sent to investigators that have submitted proposals in the last two years.

Monitoring & Data Management - The subcommittee met with the Research subcommittee and reviewed the priorities for the DNR's groundwater management practice monitoring program for fiscal year 1995. The revised priorities were included in the joint solicitation distributed by the UWS, DNR, DILHR and DATCP in November, 1994.

The two subcommittees met again in early March to review the 40 proposals which had been received as a result of the joint solicitation. Subcommittee members made recommendations which were used by the three agencies and the UWS in deciding which groundwater-related proposals to fund for fiscal year 1996.

The Monitoring and Data Management Subcommittee met twice to review existing groundwater quality databases specifically addressing the status of integration of the DNR's Geographic Information Systems (GIS) layer for well locations with the Groundwater Retrieval Network (GRN). The subcommittee plans to encourage more widespread use of Wisconsin Unique Well Numbers (WUWNs), and the continued training of staff from all agencies in accessing GRN.

The subcommittee decided it would be desirable to provide access to or integrate groundwater data from all agencies into a central system and that the expense of creating a new data system structure could be minimized by developing or clarifying certain data management processes. The subcommittee identified some of these processes as: 1) assigning WUWNs to older wells; 2) updating locational data; 3) resolving conflicting locational information; and 4) transferring large quantities of data. In FY 96 the subcommittee will document, refine and determine if these processes are feasible. The subcommittee set a goal of finding a more coordinated data system to integrate groundwater data from the various agency sources.

The subcommittee selected a new chair of the subcommittee (Jill Jonas) and plans to meet more frequently to address current issues.

Planning and Mapping Subcommittee - The Planning and Mapping Subcommittee met twice during FY 94. The primary focus of the subcommittee continues to be the review and evaluation of groundwater vulnerability mapping and analysis practices. The group addressed the usefulness

of existing models and identified additional data that are needed to better predict Wisconsin's groundwater susceptibility to contamination.

In FY 94, the subcommittee focused on two research projects, which involved comparisons of groundwater susceptibility assessment models and mapping techniques. Both studies involved atrazine contamination of groundwater in Dane County. The first project evaluated the usefulness of seven standard models for predicting groundwater susceptibility. The results indicate that the seven assessment systems evaluated were ineffective predictors of groundwater susceptibility. However, mapping aquifers and thin layers of low-permeability materials such as clay and shale may be valuable for evaluating groundwater susceptibility. In the second project, GIS tools were used to identify geologic, soils, landuse and other factors that may affect contamination in private wells. Both studies demonstrated the need for Wisconsin to develop statewide data layers that would facilitate better groundwater vulnerability assessments. These data layers include land use, soils, regional groundwater flow, hydrogeologic characteristics such as aquifer materials, and potential point sources of contamination such as underground storage tanks and pesticide spills. The studies illustrate the importance of locational data for contaminant sources. The subcommittee will continue to work on prioritizing data layers and recommend topics to the funding agencies to be included in research/monitoring priorities for the next joint solicitation to improve predictive capacity.

The subcommittee addressed national and state wellhead protection issues and identified several statewide data layers that could be developed to facilitate wellhead protection activities in Wisconsin. These layers include, but are not limited to, aquifer thickness, aquifer extents, aquifer properties, contaminant source locations, and depth to water table.

In FY 96, the subcommittee will promote and help facilitate the development of the statewide data layers described above. In addition, the subcommittee will encourage the funding of research projects, similar to those conducted for atrazine, that involve modeling and mapping of nitrate in groundwater.

Education Subcommittee - The Education Subcommittee met four times during the past year. The subcommittee continued its focus on identifying education needs, coordinating production of educational materials, and reaching consensus on the recommendations made in those materials.

Issues related to nitrate in groundwater were examined. Final agreement was reached on a "Nitrate in Drinking Water" brochure. Health effects of nitrate were included in the research priorities for the Joint Solicitation at the subcommittee's recommendation. Nitrate education will continue to be a focus of the subcommittee in the year ahead.

The subcommittee reviewed the "Radon in Private Well Water" brochure at several stages. Due to uncertainties in the status of the EPA radon standard for drinking water and the geographical distribution of radon, the brochure presented many challenges. The brochure incorporated comments from DHESS, DILHR, WGNHS, and DNR Bureau of Water Supply.

As a result of drinking water issues raised by the radon and nitrate brochures, the subcommittee added a member from the DNR's Bureau of Water Supply. To further solidify information and education efforts the Subcommittee decided that there is a need to evaluate the association between groundwater nitrate levels and the incidence of birth defects and blue-baby syndrome.



The subcommittee specifically examined needs for materials on arsenic and copper and for an interactive quiz on basic groundwater information. The Wisconsin Groundwater Resource Directory was expanded, updated, and redistributed this year. The subcommittee also examined its mission, chair and membership and decided to continue along its present course. Representatives from several agencies changed over the past year.

Local Government Subcommittee - The Local Government Subcommittee was formed in 1995 to represent local units of government and organizations representing local units of government. In FY 95 the Local Government Subcommittee began discussing how to overcome the barriers which presently hinder implementation of wellhead protection programs at the county-wide level rather than focusing solely on community level projects. The Subcommittee is presently focusing on innovative solutions to providing county-wide, wellhead protection. One plan is to promote the development and implementation of wellhead protection programs at the county level. The Local Government Subcommittee will continue to discuss issues of concern to the local units of government and develop recommendations to be presented to the GCC for future action. The Subcommittee members' interests sometimes differs from the subcommittee's mission in that members are often concerned with regulatory issues that affect their communities while the GCC is a non-regulatory body that is limited to making recommendations to the appropriate regulatory agencies regarding groundwater issues. The subcommittee will continue to communicate interests of local governments to the GCC regardless of their regulatory status.

## DIRECTIONS FOR FUTURE GROUNDWATER PROTECTION

### PRIORITY ISSUES THAT NEED TO BE ADDRESSED

- \*Distribution of findings from groundwater research or monitoring projects:** There has been considerable progress in preparing summaries of the results of groundwater-related monitoring and research projects funded through the joint solicitation process. In FY 95 the DNR and UW Water Resources Center have completed or coordinated the completion of most of the backlog of unfinished summaries. A document of these summaries has been prepared for publication. It is important that the summaries and final reports are distributed widely. More work needs to be done to target interested audiences and distribute summaries and final reports more widely.
- \*Promote consistency between the agencies on data management issues:** Through publication of the Directory of Groundwater Databases and redesign of the DNR's groundwater computer system, state and local government agencies now have more convenient access to groundwater data. Consistency has been promoted by use of translatable geolocational coordinate systems and consistent data elements for use in a GIS environment. The next step is to provide access to or integrate groundwater data from all agencies into a central system. The GCC will continue to provide leadership and communication through its Monitoring and Data Management Subcommittee. This continued effort displays the GCC's commitment to management of the resource through sound scientific methods.
- \*Reaffirmation of the GCC's intent to act as a coordinating and facilitating mechanism for the publication and distribution of information and educational materials on groundwater related issues:** The public has benefitted from the consistent educational messages which have been endorsed by the Education Subcommittee. The Education Subcommittee will continue to provide its leadership and assistance to state agencies providing educational materials to the public.
- \*Identify tools that can be used to better predict Wisconsin's groundwater susceptibility to contamination:** In FY 95, the Planning and Mapping Subcommittee reviewed and evaluated groundwater vulnerability mapping and analysis practices. The assessment systems evaluated were not good predictors of groundwater susceptibility but that mapping aquifers and thin layers of low-permeability materials such as clay and shale may be valuable for evaluating groundwater susceptibility. The studies demonstrated the need for developing statewide data layers that would facilitate better groundwater vulnerability assessments. These data layers include land use, soils, regional groundwater flow, hydrogeologic characteristics such as aquifer materials, and potential point sources of contamination such as underground storage tanks and pesticide spills. The studies also illustrate the importance of locational data for contaminant sources. In FY 96, the Planning and Mapping Subcommittee will prioritize, promote, and help facilitate the development of data layers and will recommend topics to the funding agencies to be included in the research/monitoring priorities of the next joint solicitation to improve predictive capabilities.
- \*Research on land use management and its impact on the groundwater resource:** This includes evaluation of impacts on both groundwater quality and quantity. This issue crosses agency lines and promises to be an important issue for years to come.

- \***Continued evaluation of alternatives to on-site septic systems:** As described under "Summary of Agency Responsibilities," there are currently no designs or installations of septic systems that consistently meet the state groundwater standards. Although the DNR and DLR have recently funded monitoring projects in this area, additional work is needed to find state-of-the-art solutions to the problem.
- \***Investigation of the causes and effects of nitrate in groundwater:** The GCC will support the agencies and the UWS in obtaining information pertinent to the health implications of consuming nitrate contaminated groundwater. In addition, it will continue to facilitate consistent education to provide a clear message on the many causes and effects of nitrate in groundwater for urban and rural citizens.
- \***Investigation of groundwater nonpoint pollution:** A survey by DATCP revealed that 10% of Wisconsin's wells exceed the nitrate standard and at least 12% contain one or more pesticides. These rates are substantially higher in agricultural areas. Agriculture is the major source of these pollutants. More work is needed to determine how far Wisconsin groundwater will deteriorate without a substantial change in farming practices, and what practices will sustain agriculture and groundwater quality.
- \***Improved communication between local and state government:** The Local Government Subcommittee to the GCC was created in February 1993 to provide a line of communication between local and state governmental entities. The Local Government Subcommittee has found that the interests of its members sometimes differs from its mission. The Local Government Subcommittee members are often concerned with regulatory issues that affect their communities while the GCC is a non-regulatory body limited to making recommendations to the appropriate regulatory agencies regarding groundwater issues. To increase the responsiveness of state agencies to local government needs, these needs must be communicated to the GCC and to the appropriate agencies. The Subcommittee meeting minutes are provided to the GCC so that members are aware of the concerns that are present at the local level. An effort must be made by the GCC to acknowledge that these concerns exist, and pass the information to the appropriate regulatory agency.
- \***Investigation of adverse impacts from groundwater withdrawals:** In FY 95, DNR staff with help from the Groundwater Quantity TAC began preparing a report on the groundwater quantity issue (see "Condition of the Resource - Groundwater Quantity"). In the report, localized areas with groundwater quantity problems are identified and the effects of groundwater withdrawals on surface waters and long-term groundwater availability are discussed. There is a need to further quantify hydrographic relationships of surface and groundwater. The GCC should continue to encourage research efforts that will provide information useful in addressing this issue.

## APPENDIX

**Wisconsin Groundwater Coordinating Council**  
**Meeting Minutes**  
**August 12, 1994**

**Members Present:** Susan Sylvester (DNR), Esther Chapman for Nick Neher (DNTCP), Henry Anderson (DHSS), Bennett Burks for Marvin Roshell (DILHR), Jack Metcalf (Governor's Representative), and Ron Hennings for James Robertson (WGNHS).

**Others Present:** Jeff Postle (DNTCP), Jack Connolly, Jeff Helmut, Steve Karklins, Mike Lemke, David Lindorff, Terry Lohr (DNR), Steve Smiley (In-Sink-Erator), Tom Dawson (Public Intervenor), Bill Ryan (U.S. EPA), Jim Kaap (U.S. SCS), Jim Peterson (UW Ext.), Kevin Fermanich and Kevin McSwengy (UW Soils), and George Blondin (UW WRC).

The meeting was held in room 511 of the GEF 2 Building in Madison, beginning at noon.

**1. Introductions**

Introductions were made.

**2. Agenda Review and Changes**

One modification was made to the agenda. Dave Lindorff said that Jeff Helmut would give the DNR status update on Research/Monitoring project summaries.

**3. Approval of Minutes**

The minutes of the May 13, 1994 Groundwater Coordinating Council meeting were approved as written.

**4. Status Reports**

a. Education Subcommittee - Jim Peterson reported on the actions of the Education Subcommittee at their July 21 meeting. The Subcommittee discussed the nitrate conference held in Stevens Point and recommended that a nitrate conference be held more often. To further solidify information and education efforts the Subcommittee decided that there is a need to evaluate the association between groundwater nitrate levels and the incidence of birth defects and blue-baby syndrome. Jim handed out a paragraph from Lynda Knobloch (DHSS) which stated "In order to conduct meaningful studies, funding would be needed to allow retrieval of existing health outcome data and to develop an efficient method for matching health outcome data and water quality data sets. The possibility of revising the public health statutes to require health care providers to report cases of methemoglobinemia and abnormal prenatal screening tests to the Division of Health was also discussed."

The status of the joint DNR-DHSS "Nitrate in Drinking Water" brochure was discussed. Mike Lemke stated that there are still differences to be worked out but that they would be resolved to produce a joint brochure. Henry Anderson said that the DNR-proposed language may conflict with DHSS' Women, Infants and Children (WIC) program diet recommendations. Henry is concerned that nitrate is not taken seriously enough and believes that a study should be done on birth defects associated with nitrate and

suggested that it be made a research priority. Henry agreed that DNR and DSHS will work together to resolve this issue. Ron Hennings brought up the UW-Extension nitrate bulletin which has just been published and emphasized the importance of utilizing the Education Subcommittee to facilitate a consistent message. Bill Ryan said he would check with the EPA drinking water division to see what their plans are for the nitrate issue.

Other topics discussed by the Education Subcommittee were preparation of a radon brochure and revision of the Education Resource Directory. Jeff Helmutz stated that he and Steve Karklins will have a draft "Radon in Drinking Water" brochure completed by October 1. Jeff also stated that he will have a draft revised Groundwater Education Resource Directory completed by October 1. Jim Peterson reported that the Subcommittee may produce a publication of cartoons of groundwater myths.

b. Groundwater Quantity Meeting - Dave Lindorff handed out a DNR summary and Tom Dawson's notes that summarized a July 27, 1994 meeting on groundwater quantity. Concrete ideas to come out of the meeting were: 1) potential identification of areas sensitive to groundwater withdrawals, 2) consideration of discretionary regulation of high capacity well licensing, and 3) asking the GCC to address the need for a report summarizing the status of the groundwater quantity issue for the Natural Resources Board. Tom Dawson emphasized the importance of the issue and stated that the GCC is the correct mechanism by which to recognize the groundwater quality/quantity connection and to generate a report on it.

Susan Sylvester asked the Council what role it should play. Ron Hennings stated that the issue is complex and it could take years to fully explore this issue. Ron said that there are questions dealing with water use values that need to be addressed and that DNR field staff should be utilized to locate potential problem areas. Susan Sylvester said that the DNR will prepare a report with input from others and will also raise the issue as a priority topic for research. Mike Lemke said that the Groundwater Management Section would put together a white paper on the issue and that the issue would be made a DNR research priority for the upcoming joint solicitation process. Ron Hennings said that Alex Zaporozec would be available to help with the report.

c. Research/Monitoring project summaries - George Blondin outlined some of the steps the WRC has taken to make project summaries accessible by computer through the National Library System and Wiselinfo online services. George said that the WRC staff has begun to write summaries but is also working on publication of 19 old and 12 new technical reports by the end of the year. They have ordered 6000 copies of a cover to be used on final reports and will make 75 copies of each final report. Ron Hennings asked to have an update on progress made at the November GCC meeting. George agreed and also offered to help the DNR access the online systems for their summaries.

Jeff Helmutz discussed preparation of summaries of DNR-funded projects. Jeff has prepared three summaries and is working on finalizing the summary format. Jeff stated that he planned to have 25 summaries prepared by October 1, 1994. Copies of all final reports and summaries will be distributed by the WRC. Copies of final reports will be generated upon demand.

d. Comprehensive State Groundwater Protection Plan (CSGWPP) - Mike Lemke stated that he had been working with the EPA for endorsement of Wisconsin's plan as a fully implementing plan, but that the EPA doesn't plan to endorse any state's plan as fully implementing. The EPA would like to approve Wisconsin's plan as a core program. We have received minor comments on our plan from the EPA. Mike also stated that at the Groundwater Protection Council meeting in Salt Lake City he found that 50% of the states have no CSGWPP plan at all and that many of them are waiting to see what comes from Wisconsin's and Alabama's submittals.

e. LBHR 83 - Bennette Burks reported that there was a staff draft of the rule ready for the advisory code committee. The proposed rule would be performance based and would include a proposed timeline for compliance, a coliform standard of < 1 org/ml, a nitrate standard of < 40 mg/l ratcheted down to 10 mg/l by 2007 and a maintenance requirement of 1 servicing per year. In addition maintenance data and payments would be made through automated teller-type machines.

5. Approval of FY 1994 Report to the Legislature - Jeff Helmuth handed out a list of 4 proposed changes to the Final Draft of the 1994 Report to the Legislature. He asked that the Report be approved by the Council with the proposed changes and the appendix which was unchanged from the first draft. The Council unanimously approved the Report.

6. DATCP Groundwater Monitoring for Pesticides - Jeff Postle presented a summary of his research conducted since 1985 to (1) determine the extent of groundwater contamination from pesticide use at 50 sites in susceptible areas of the state and (2) assess the need for regulatory action to prevent groundwater contamination. He discussed characteristics of susceptible areas, well nest configuration, analytical results for groundwater pesticide, and nitrate analyses. Jeff handed out a summary sheet that detailed the project results. Jeff's research has: 1) provided data to modify the aldicarb rule, 2) showed that atrazine contamination problems exist, 3) shown that the Central Sands and Lower Wisconsin River Valley areas differ in their pesticide leaching characteristics, 4) acted as an early warning system, and 5) shown that farmers will cooperate.

7. Herbicide and Nitrate Movement in Sandy Soil in the Lower Wisconsin River Valley - Kevin Fermanieh reported on University of Wisconsin column and field studies of factors affecting the pesticide leaching characteristics of Lower Wisconsin River Valley (LWRV) soils. Kevin showed that management practices such as band-application of herbicides, corn/soybean crop rotation, ridge tilling, cultivating for weed control, and ridge-applied nitrogen significantly lessened pesticide leaching to groundwater. Kevin pointed out the transient nature of pesticide leaching in the LWRV which is driven by rainfall and irrigation. Dithylatrazine was the major atrazine residue found. The impact of two new pesticides, Nicosulfuran and Imazethapyr was also investigated. Kevin McSwiney estimated that for the close to \$1 million dollars invested in the project, there have been 11 or 12 peer-reviewed publications so far and estimated that 20 to 25 peer-reviewed articles would eventually be published. Tom Dawson was very impressed with the project and suggested that a similar study be conducted in Dane County.

8. Adjournment & Next Meeting

The meeting adjourned at 3:00 pm. The next meeting of the Groundwater Coordinating Council will be at noon on November 4, 1994 at the Department of Agriculture, Trade and Consumer Protection

Respectfully submitted,

Jeff Helmuth  
Groundwater Management Section  
Department of Natural Resources



**Wisconsin Groundwater Coordinating Council**  
**Meeting Minutes**  
**November 4, 1994**

**Members Present:** Susan Sylvester (DNR), Nick Nehrer (DATICP), Jack McTeal (Governor's Representative), Bob Pearson for Carol Cutshall (DOT), James Robertson (WGNHS).

**Others Present:** Beth Holl, Rick Stoll, Mike Hrongk, Jeff Helmuth and Mike Lemcke (DNR), Jim Raap (US SCS), Steve Born (UW), Ron Hennings (WGNHS) Jeff Postle and Lisa Morrison (DATICP).

The meeting was held in the DATICP Board Room, 801 W. Badger Road, Madison, beginning at noon.

**1. Introductions**

Introductions were made. It was noted that three of the eight council members were not present or represented. The Council expressed concern over their unexplained absence.

**2. Agenda Review and Changes**

One modification was made to the agenda. George Blondin of the Water Resources Center (WRC) would not be present to give a status update on Research/Monitoring project summaries. Instead George had sent a 1-page explanation of the WRC's activities to be distributed at the meeting.

**3. Approval of Minutes**

The minutes of the August 12, 1994 Groundwater Coordinating Council (GCC) meeting were approved as written.

**4. Status Reports**

**Education Subcommittee** - Ron Hennings reported on the actions of the Education Subcommittee at their October 20th meeting.

Nitrate in Drinking Water brochure: Ron Hennings reported that the subcommittee had reviewed a brochure that DHESS had produced without the DNR's endorsement. Mike Lemcke stated that Bob Krill and Henry Anderson are resolving minor differences in language and that a joint brochure would be produced soon. The possibility of having someone from the Bureau of Water Supply on the subcommittee was discussed. Jeff Helmuth added that there will be a half-time position in the Bureau of Information and Education that may be utilized to work on Water Supply brochures in the future.

Radon in Drinking Water brochure: The subcommittee discussed the draft radon brochure prepared by Steve Karklins and Jeff Helmuth that incorporated comments from DHESS, DILHR, WGNHS, and Bureau of Water Supply. Ron stated that after much discussion the subcommittee had found the draft brochure to be too technical and that it should be revised to remove material related to radon in air. There was also some concern that the brochure was not specific enough regarding health risks. At the subcommittee meeting

Cathy Cliff said that the brochure would have to be rewritten in a more simple, user-friendly style.

Susan Sylvester asked when the brochure would be completed. Mike Lemke said that Steve Karklins and Jeff Helmut had already spent a lot of time on the brochure and that he could not give a time frame for the brochure's completion. The brochure may be passed back to Water Supply, which now has a part-time I&C person, to complete. Jack Metcalf stated that he felt nitrate was a more important issue and asked if there was public interest in radon. Ron Hennings said that there was public interest and that it was important to finish the brochure. Nick Nether added that the risks must be communicated effectively. There was discussion on the uncertain status of the EPA radon in drinking water standard and geographical distribution of radon. Ron proposed that an additional, more detailed informational pamphlet be prepared which would be made available on request.

Groundwater Education Resource Directory Ron stated that the revised Directory was near completion and that no national materials would be included. Jeff Helmut added that he was expecting a few more comments and that a final draft should be distributed to subcommittee members within a few weeks.

**Research/Monitoring project summaries** - Jeff Helmut handed out an update from George Blondin on the WRC's reporting progress. Four final reports had been published and another 5 were in the final stages of editing. In addition Jeff relayed that 4 other reports were being reviewed by the authors. The WRC is publishing 75 copies of each final report. Little or no work had been completed on preparing summaries. Several members of the GCC expressed frustration that neither Al Beaver or George Blondin were present. Ron Hennings asked to have George Blondin give an update on progress made by the WRC at the February GCC meeting. The Council agreed that this was a good idea. Susan Sylvester said she would contact the WRC and asked Jeff to provide her with the history of the GCC's decisions on summary preparation by the WRC. Steve Born gave a history of the joint solicitation process and said that there should be an assessment of how the research/monitoring results are being utilized.

Jeff Helmut said he had prepared draft summaries of 26 DNR-funded projects. These summaries are being reviewed by principal investigators. Ten of these had been approved by principal investigators. Copies of all final reports and summaries will be distributed by the WRC. Jeff also mentioned a database he had started for tracking research/monitoring project status. By next May, Jeff plans to complete, or coordinate the completion of the 32 remaining summaries for all DNR-funded, DHEH-funded and DATCP-funded research/monitoring projects ending in FY 94 or earlier. Jeff said he could have a draft publication of the 58 summaries ready for approval at the 5/12/95 GCC meeting. Susan Sylvester stated that summaries from all agencies, including UW, should be published together and that she would talk to George Blondin about the WRC's progress.

**Comprehensive State Groundwater Protection Plan (CSGWPP)** - Mike Lemke stated that Wisconsin, Alabama, and New Hampshire had submitted their plans at the same time and that the EPA was still reviewing them but would probably endorse Wisconsin's program. Mike emphasized that the EPA was very impressed with the GCC. Mike added that the EPA was soliciting ideas from the states on what federal oversight should include.

5. Approval of FY 1996 Joint Solicitation Package - Comments from UWS, DNTCP, DILHR and DNR staff had been incorporated into the package before it was sent to the GCC members for them to review before the meeting. The Council unanimously approved the package without further changes.
6. Geographic Information Systems (GIS) - Surface Water Integration - Beth Holl described how the DNR will integrate surface water data systems and link these data systems to a computerized surface water layer with the goal of building a GIS infrastructure to support ecosystem management. The GIS 1:24,000 scale hydrography layer will be connected to existing Oracle systems and provide new tools to analyze, view and report information. The technical design of the layer is being completed and integrated information systems are being developed. The Department has submitted a budget issue to DOTA for development of the statewide hydrography layer. DNR is also looking for sources of cooperative funding.
7. Utilizing GIS for Groundwater Management in the Lake Michigan District - Rick Stoll and Mike Hronek explained that DNR records (paper files) had been used to construct databases of physical features, contaminant sources, orchards and wells to be used in the Lake Michigan District (LMD) GIS system. The LMD is the only district using such a system. Work completed on naturally occurring arsenic in water supply wells was used to demonstrate the power of the system. Rick said that arsenic is of such a concern in the area that banks require a water test for real estate loans. With the arsenic data, Rick and Mike demonstrated how queries result in maps of varying content, scale and complexity. One problem that exists is that of getting information in a useable form. This brought up the need for spatial location of Underground Storage Tanks in DILHR's database.
8. Approval of Proposed Meeting Schedule for 1995 - Dates were set for 1995 GCC meetings: February 17 at WGNHS; May 12 at Dodgeville; August 18 at DNR; November 10 at DNTCP. All meetings will start at noon.

9. Adjournment & Next Meeting

The meeting adjourned at 2:45 pm. The next meeting of the Groundwater Coordinating Council will be at noon on February 17, 1995 at the Conference Room of the Wisconsin Geological and Natural History Survey, 3817 Mineral Point Road.

Respectfully submitted,

Jeff Helmut, Water Resources Management Specialist  
Groundwater Management Section  
Department of Natural Resources

**Wisconsin Groundwater Coordinating Council  
Meeting Minutes  
February 17, 1995**

**Members Present:** Susan Sylvester (DNR), Nick Nehrer (DNTCP), Jack McTeal (Governor's Representative), Carol Cutshall (DOT), James Robertson (WGNHS), Bennette Burks (DILHR), Carl Peace for Al Beaver (UWS), Lynda Knobloch for Henry Anderson (DHS).

**Others Present:** Dave Lindorff, Jeff Helmut and Mike Lemke (DNR), Ron Hennings (WGNHS), George Blondin (UWS), Lisa Morrison (DNTCP), Bob Pearson (DOT), Chuck Warzecha (DHS), and Jon Cleveland and Gary Lucek (WRWA).

The meeting was held in the Wisconsin Geological and Natural History Survey Conference Room, 3817 Mineral Point Road, Madison, beginning at noon.

**1. Introductions**

Introductions were made. Susan Sylvester welcomed Bennette Burks as a new Council member.

**2. Agenda Review and Changes**

No changes were made to the agenda.

**3. Approval of Minutes**

The minutes of the November 10, 1994 Groundwater Coordinating Council (GCC) meeting were approved as written.

**4. Subcommittee Reports**

**Planning and Mapping Subcommittee** - Lisa Morrison as the new chairperson of the subcommittee reported that the subcommittee had met twice, on December 14th and February 16th, since the last GCC meeting. Discussion in both meetings had centered on the results of the Groundwater Susceptibility Assessment project. The results indicate that the seven assessment systems evaluated were not good predictors of groundwater susceptibility. The subcommittee will continue to work on prioritizing data layers and will recommend topics to the funding agencies to be included in research/monitoring priorities of the next joint solicitation to improve predictive capabilities.

**Monitoring and Data Management** - Chuck Warzecha reported on the December 14th meeting. The subcommittee had discussed the results of the CDC Private Well Survey which was performed as a follow-up to the flood of 1993. Chuck indicated that there will be money available for a CDC follow-up study and that Jon Standridge is doing research on using total coliform as an indicator of unsafe wells. Jon is hoping to receive money from CDC to help with this research. A subdivision near Marshfield turned up high concentrations of radioactive substances in drinking water wells. Chuck also indicated that it was difficult to recommend solutions. Ron Hennings added that other subcommittees were struggling with the problem of what to recommend to the public with regard to contaminated wells. Susan Sylvester encouraged input from the GCC on these issues.

**Education Subcommittee** - Jeff Helmuth reported on the actions of the Education Subcommittee at their January 24th meeting. There had been discussion of the educational usefulness of water or groundwater "festivals" and agreement that more sustained efforts would have more lasting results. The subcommittee heard presentations on the DNTCP atrazine, alachlor and nitrate results, proposed nitrate regulation in the DNTCP budget initiative and agricultural nonpoint source groundwater pollution. The subcommittee briefly discussed approaches to education about agricultural chemicals in groundwater. That topic will be picked up again at the next meeting. The subcommittee will review and if necessary, update the "Copper in Drinking Water" brochure. Another "Radon in Drinking Water" draft brochure has been completed and will be approved and/or discussed by the subcommittee at its April meeting. There will be a second printing of the Groundwater Education Resource Directory of approximately 1000 copies. There was consensus by the subcommittee that a separate document addressing corrective options to private well problems for the Bureau of Water Supply was appropriate but that it would be impossible to make specific recommendations in that document. The subcommittee also talked about making research on the effectiveness of various types of messages and what actions people might take in response a research priority for the next joint solicitation.

## **5. Status Reports**

**Research/Monitoring project reports/summaries** - Jeff Helmuth reported that he has continued to prepare summaries in the format agreed upon by the Research Subcommittee. He has received approval by principal investigators on 20 of the 28 summaries. Eighteen more are in various stages of preparation. Jeff plans to have all 46 summaries of DNR projects completed by May. DNTCP and DLEHR projects should also be summarized by that time. Jeff hopes to have a draft summary publication ready for approval at the May meeting.

To update the UW Water Resources Center (WRC) Library's collection of project final reports, Jeff has been making copies of DNR project final reports and sending them over. The WRC now has 67 of 108 DNR reports. Jeff plans to get the rest of them over to the WRC Library by this spring.

George Blondin handed out a report that covered the WRC's progress and goals for preparing final reports and summaries of research projects. George has been delayed in preparing summaries and final reports due to concerns over WRC funding for FY 96 and FY 97. George estimated that, of the 26 remaining reports to be completed, the WRC will have 13 final reports completed by July 1995. The remaining 13 final reports will be completed in FY 96. There has been some problem with "unreadable" final reports submitted by principal investigators. GCC members showed concern over this (see discussion below).

George also stated that two summaries have been completed in a format similar to the standard two-page format now used by the DNR. George listed seven modifications that the WRC intends to adopt for UWS summaries. Jeff Helmuth agreed that the modifications seemed reasonable and he will adopt George's suggestion to include a WRC reference services call number. George agreed to have 16 summaries completed by the end of FY 95. Gordon Chesters has indicated that the WRC will rewrite the original 21 summaries published in a narrative format in the standard format. Sixteen more projects will be due in FY 96 that must also be summarized. George included examples of summaries in two other formats that he hopes to use for Wiselno and other applications.

There was discussion about how to handle investigators with problem final reports. Though the DNR can withhold a final payment until an acceptable final report is turned in, the UWS cannot. Earl Peace recommended creating a list of investigators ineligible for funding due to problem reports. Several Council members had reservations about making researchers ineligible due to situations that may not be under their control but all agreed that researchers must be made accountable. It was agreed that Jamie Robertson, Susan Sylvester, Nick Nether and Earl Peace would meet to draft a solution to the problem for next year's joint solicitation. Susan Sylvester asked Jeff Helmuth and George Blondin for a report on each project's reporting status by the May meeting.

To follow up on the accountability discussion held at the November meeting, Jeff Helmuth had talked to Steve Born (UW) about assessing the utility of the research/monitoring program. Steve thinks that we must go beyond the "Benefits from Groundwater Monitoring and Research" section of last year's Report to the Legislature and recommends a more systematic approach that would show the demonstrated utility from each project. Since this would take some time, Steve suggested that it would be appropriate to use some of the groundwater research/monitoring money (\$10-20,000) to fund a utility evaluation.

**Comprehensive State Groundwater Protection Plan (CSGWPP)** - Mike Lemke said that Wisconsin was one of the first four states endorsed nationally for their CSGWPP. This endorsement once again sets Wisconsin ahead as a national leader. In addition, Laura Chern, of his staff has already solicited comments on a state vision for federal change document. It will take some time to assimilate this information into a concise package. The agencies will each be contacted for additional input once the package is together. Susan Sylvester and Jack Metcalf emphasized the uniqueness and importance of the GCC in coordinating cohesive groundwater management.

**Pesticide State Management Plans** - Lisa Morrison handed out a draft generic State Management Plan (SMP) for Pesticides which had been prepared by DNTCP and DNR over the past two years. The EPA has encouraged each state to prepare a generic SMP stating how it will generally manage all chemical pesticides to assure groundwater protection. If the EPA determines that a pesticide presents a significant risk of leaching to groundwater in a state, it will either cancel the registration of that compound or allow the state to prepare a pesticide specific SMP describing how the state will manage the pesticide to protect groundwater. Pesticide specific SMPs will be based on the generic document which the EPA will already understand and will have approved. Lisa went through the 12 components of the generic SMP. This summer the EPA will publish a list of pesticides for which individual SMPs will be required. DNTCP hopes to submit the generic SMP to the EPA in May.

**FY 1996 Joint Solicitation** - Jeff Helmuth reported that 40 proposals were received in response to this year's joint solicitation. The proposals have been categorized, copied, and distributed to the members of the Monitoring & Data Management and Research Subcommittees, 17 DNR staff and reviewers selected by George Blondin for UW. The two subcommittees will meet March 9th to discuss the proposals. After the meeting the proposals will be rated and ranked to decide which will be funded. Jeff added that during the course of the joint solicitation, several areas needing improvement became apparent and that these areas will be addressed in next year's solicitation.

**Future Direction** - Mike Lemke handed out a summary mid-year status of progress made on "Directions for Future Groundwater Protection" from the 1994 GCC Report to the Legislature.

Mike ask that Council members review the summary and send their comments to Jeff Helmuth, WR/2 (e-mail "HELMU@DNR.STATE.WI.US").

**6. Urban Stormwater Infiltration: Assessment and Enhancement of Pollutant Removal** - Dave

Armstrong gave a presentation on column studies he had completed with atrazine, polycyclic aromatic hydrocarbons (PAHs), copper, and zinc transport through soils to determine whether soil can attenuate contaminants and whether the retardation equation can successfully predict contaminant transport in soil columns. Dave gave some background on controlling processes and how distribution and retardation processes are quantified. They found measured  $K_d$  (distribution coefficient) values compared well to predicted values though several factors contribute to uncertainty in the  $K_d$ . Other research findings included: 1) PAHs are readily bound to soil; 2) atrazine moved through soil quickly; and 3) zinc only moved a short distance in the soil. It appears that organic matter content slows contaminant transport. Overall, the retardation equation proved useful for comparative assessments of mobility during infiltration as related to soil and contaminant characteristics. However, the retardation model should not be used for simulation of actual transport at field sites because the model does not account for dispersion, removal and/or retention reactions and may greatly overestimate contaminant transport.

**7. Adjournment & Next Meeting**

The meeting adjourned at 3:15 pm. The next meeting of the Groundwater Coordinating Council will be at noon on May 12 in the Conference Room of the DNR Area Office in Dodgeville.

Respectfully submitted,

Jeff Helmuth  
Water Resources Management Specialist  
Department of Natural Resources

**Wisconsin Groundwater Coordinating Council  
Teleconference Minutes  
April 24, 1995**

**Members Present:** Susan Sylvester (DNR), Henry Anderson (DHS), Al Beaver (UW System), Carol Cutshall (DOT), Bennette Burks (DILHR), Ned Zuglsdorff for Nick Neyer (DATICP), and Ron Hennings for James Robertson (WGNHS).

**Others Present:** Gordon Chesters and George Blondin (UW-WRC); Dave Lindorff and Jeff Helmut (DNR).

The only agenda item for the teleconference was to review the proposed University of Wisconsin System (UWS) groundwater research plan for fiscal year (FY) 1996 which begins July 1, 1995. Gordon Chesters and George Blondin provided a summary of the Proposed UWS Groundwater Research Plan for FY 96 (see attachment) and summarized the projects selected for funding. George explained how the Groundwater Research Advisory Council had adjusted some projects' standings in the rankings.

The UWS will fund eight new projects at a cost of \$173,115 including one project co-funded by the DNR. Six projects which are being funded by the UWS in FY 95 will carry over to FY 96. The total cost for those 6 projects in FY 96 will be \$126,887. Bennette Burks indicated that DILHR would fund the second year of a currently UWS-funded project by John Harkin.

The GCC unanimously endorsed the recommended UWS groundwater research plan for FY 96 and the transmittal of that endorsement to the Department of Administration for release of funds. Letters of endorsement will be sent to the UWS and the Department of Administration.

Ron Hennings asked for clarification of an item in the March 24 GRAC meeting minutes related to better communication between state agencies and UWS researchers to promote groundwater policy research funded by UWS. Gordon Chesters explained that it has been difficult obtaining proposals related to groundwater policy options that are eligible for UWS funding. Susan Sylvester indicated that there is a need for more complete tracking of projects and documentation of the usefulness of their results. Ron suggested that the Research Subcommittee address this issue.

Respectfully submitted,

Jeff Helmut  
Water Resources Management Specialist  
Wisconsin Department of Natural Resources



**Wisconsin Groundwater Coordinating Council**  
**Meeting Minutes**  
**May 12, 1995**

**Members Present:** Susan Sylvester (DNR), Nick Nehr (DATICP), Jack McTeal (Governor's Rep.), James Robertson (WGNHS), Henry Anderson (DHSS), Roman Kaminski for Bennette Burks (DILHR), Carl Peace for Al Beaver (UWS), Bob Pearson for Carol Cutshall (DOT).

**Others Present:** Mike Lemekz, Jack Connolly, Dave Lindorff, Jeff Helmuth (DNR), Ron Hennings (WGNHS), George Blondin (UWS).

The meeting was held in the Conference Room of the DNR Area Office in Dodgeville, beginning at noon.

**1. Introductions** - Introductions were made.

**2. Agenda Review and Changes** - Jeff Helmuth said that he would give the Local Government Subcommittee report for Jay Payton and that Ron Hennings would give the Planning and Mapping Subcommittee report for Lisa Morrison.

**3. Approval of Minutes** - The minutes of the February 17 meeting and April 24 teleconference were approved as written.

**4. Continuation of GCC** - Susan Sylvester updated the GCC on the status of the "sunset" proposed for the GCC in the proposed biennial budget. She explained that the potential termination of the GCC and other state councils and committees would be reviewed by the Office of the Lieutenant Governor this fall but that it is uncertain as to how the review process will proceed. There was strong consensus that the GCC should be continued from the members. Susan proposed that a draft 2-page document addressing the continuance of the GCC be prepared for discussion at the August meeting. Susan asked that the document be approved by the GCC for signature by each of the state agency's Secretaries. Jack McTeal stated that he felt the GCC was valuable and that he would contact the Lieutenant Governor. Jeff Helmuth agreed to prepare the draft document and to find out more about the Lieutenant Governor's review process. The DNR will take the lead on keeping abreast of the issue.

**5. Subcommittee Reports**

**Planning and Mapping Subcommittee** - Ron Hennings reported that the subcommittee had discussed the results of studies by the WGNHS on the presence of atrazine in Dane County groundwater using several susceptibility evaluation systems. None of the systems predicted atrazine contamination of groundwater reliably. The presence of atrazine in groundwater was most closely predicted by atrazine usage. Due to its more conservative nature, the subcommittee agreed that nitrogen would have been a more useful tracer than atrazine. The results suggested that mapping aquifers and thin layers of low-permeability materials such as clay and shale may be valuable for evaluating groundwater susceptibility.

Ron explained that the connection between atrazine usage and atrazine contamination of groundwater illustrates the importance of locational data for contaminant sources. The subcommittee believes that this is also true for leaking underground storage tanks (LUST) and is drafting a resolution to request that Wisconsin Land Information Board (WLIB) funds

be made available to incorporate the DILHR LUST database into a Geographic Information System (GIS). A draft resolution will be sent to GCC members before the August meeting. Nick Nether said that WLB funding has already gone to counties for base maps, and that GIS efforts will be encouraged.

**Education Subcommittee** - Ron Hennings reported that the Education Subcommittee has elected Chris Meehenich as sole chair and has added Bill Rock from the DNR Bureau of Water Supply as a new member. At its April 19th meeting the subcommittee discussed its future direction. The discussion centered on whether to take on specific, pro-active, long-term goals as opposed to responding to educational needs as they came up. Ron asked the GCC for guidance on what the role of the subcommittee should be. Susan asked how much of a time-commitment would be required to assume a more pro-active, goal-oriented approach. Mike Lemcke said that there was little time available for additional subcommittee support work but suggested coming up with a list of goals for consideration. Susan said that the GCC would like to see a list of goals and estimates of time required to achieve the goals

**Local Government Subcommittee** - Jeff Helmut reported that the Local Government Subcommittee had held a meeting on March 15th which had focused on county delegation of construction, location and abandonment of private wells. Ken Christopherson of the Bureau of Water Supply had explained how the program operates and identified issues to consider before implementing the program. The subcommittee discussed barriers that have prevented counties from implementing the program and how these barriers could be overcome. The subcommittee also discussed county implementation of wellhead protection (WHP) programs and on how best to reach key people that could help implement WHP at the county level. It was decided that Jay Payton will look into being placed on the agenda for the fall convention of the Wisconsin County Code Administrators to talk about county implementation of WHP programs. There was also discussion about contacting other organizations to reach more people. The subcommittee also decided to try to bring in people from local governments to join the subcommittee. Jack Metcalf suggested contacting the Mayor of Dodgeville, Jim McCauley about joining the subcommittee.

**Monitoring and Data Management** - Mike Lemcke reported that the Monitoring and Data Management Subcommittee had met on May 9th to discuss the Groundwater Retrieval Network and the Well Construction Report database. The subcommittee established that there is a need to document a process for deciding which of conflicting well location information to use. Use of Wisconsin Unique Well Numbers (WUWN) was identified as a means of improving data quality. The subcommittee set a goal of finding a more coordinated data system to integrate groundwater data from the various agency sources. Susan Sylvester said she would like to see the data linked. George Blondin suggested looking at the GIS application, "Wellhead", used to integrate subsurface data in different formats in a project funded by UWS ("Integrated Decision Support for Wellhead Protection").

**6. Approval of "Radon in Private Wells" brochure** - Jeff Helmut handed out a final draft of the "Radon in Private Well Water" brochure. Some corrections and editorial comments were made. There were no objections to the text of the brochure as amended. Jeff said the brochure would be published soon.

## **7. Status Reports**

**DATCP Nitrate Initiative, Alachlor Survey, Aectochlor Monitoring, Atrazine Survey and Aldicarb Registration for Use on Soybeans** - Nick Nehrer reported that the DATCP Nitrate Initiative, which proposed regulating fertilizer and manure use, had been voted down by the Joint Finance Committee. Nick said the DATCP will study what other states are doing and develop an educational strategy. Only 30% of farmers are crediting manure nitrogen and only 3-6% are crediting it correctly. There was a discussion of potential conflicts between cash crop and livestock farmers due to cropping practices contaminating groundwater used for livestock. Jack Metcalf agreed that there was the potential for conflict but added that livestock production is decreasing dramatically in the state because economics favor cash grain crops.

Nick handed out the final report on the DATCP Alachlor Survey. He emphasized that sampling was focused on wells that had atrazine detects. DATCP will do site investigations where there were alachlor enforcement standard exceedances and will prohibit alachlor use on a site specific basis. Nick also gave updates on other pesticide-related developments: 1) DATCP is requiring 25 monitoring wells to be installed by July 1st for producers to monitor for aectochlor at pilot test plots; 2) The Atrazine Survey is being developed - prohibition areas should be expanded in August; 3) Aldicarb has been registered for use on soybeans but will not be used in Wisconsin in the near future; 4) The pesticide cleanup fund was reduced by 3.1 million dollars.

**Groundwater Quantity** - Dave Lindorff gave a brief review of the status of the groundwater quantity paper being written by the DNR's Groundwater Management Section. Dave said that they would have something ready to include in the GCC Report to the Legislature in August.

**MTBE concerns in Southeast District** - Dave Lindorff gave some background on the methyl tertiary butyl ether issue. Concern over MTBE and ethyl tertiary butyl ether (ETBE) in groundwater was caused by a reports of MTBE contamination in 23 of 29 wells in Denver, CO. As a result sampling was performed in southeast Wisconsin. Dave explained that neither MTBE or ETBE were detected in water samples collected from four public drinking-water treatment systems in southeastern Wisconsin or from raw and treated water from the Milwaukee Metropolitan Sewerage District's Jones Island plant. Dave noted that many people were concerned about the issue and that DHS was conducting a health study on MTBE.

James Robertson asked that people contact Warren Gebert (USGS) to encourage sampling for MTBE in Milwaukee as part of a National Water Quality Assessment study. Warren's telephone number is (608) 276-3801.

**Joint Solicitation Process** - Jeff Helmuth said that letters were sent to James Klausner of the Department of Administration and Katherine Lyall of the University of Wisconsin System to release funds for the 1996 UWS groundwater research plan. Seventeen of the 40 proposals received will be funded in full or in part through the joint solicitation process. Jeff added that as part of the Continuous Quality Improvement process a survey will be sent out to investigators who have submitted proposals in the past two years to assess how the joint solicitation is working. The results of the survey will be used when preparing the FY 1997 joint solicitation package. James Robertson, Nick Nehrer and Earl Peace proposed language to be included in the 1997 joint solicitation package to address problem final reports. There was consensus to include the draft language in the package.

**Research/Monitoring Project Final Reports and Summaries** - Jeff Helmuth handed out a table summarizing the status of final reports and summaries for projects funded through the joint solicitation process. He also handed out a draft document of summaries. Jeff said that he and George Blondin planned to complete the document by the August meeting. The document will include agency projects funded up to 1994, and UWS projects funded up through at least 1995. Approximately 70 to 80 summaries will be included. George Blondin reported that he had talked to most investigators responsible for problem reports and that, in most cases, the reports would be forthcoming.

**8. Outline for 1995 GCC Report to the Legislature** - Jeff Helmuth handed out a draft outline for the 1995 GCC Report to the Legislature. Jeff said that the "Benefits of Research and Monitoring" and "Condition of the Resource: Groundwater Quantity" sections would be expanded.

**9. Groundwater Monitoring at Solid Waste Disposal Sites** - Jack Connelly gave an overview of 7 projects he and others in the DNR's Bureau of Solid and Hazardous Waste Management (BSHWM) have worked on from 1985 to 1994 and which have been funded through the joint solicitation process. Jack focused on the impacts these studies have had on regulations and monitoring practices.

The first two studies (conducted from 1985 to 1988) revealed for the first time that groundwater around many Wisconsin landfills was contaminated by volatile organic compounds (VOCs). The studies also showed that volatile organic compound (VOC) contamination of groundwater was more common at unengineered municipal solid waste landfills than at other types of landfills. A follow-up VOC study (conducted from 1992 to 1994) showed that VOC levels have decreased at most of the unengineered landfills though at many of the sites VOC levels do not show continued decline. There was no VOC contamination definitely attributable to leachate migration at any of the older, engineered landfills studied which confirmed that these sites are performing as BSHWM staff had hoped. The results of the three VOC studies have been used to establish requirements for VOC sampling at new and existing landfills. These studies have also indicated that inorganic compounds could be useful in predicting VOC contamination at landfills. Therefore, until recent EPA rules required VOC monitoring, the BSHWM allowed sites to sample for inorganic parameters as part of routine monitoring and not sample VOCs until inorganics are elevated. The VOC studies provided valuable data which was used to convince EPA to reduce the number of VOCs required to be sampled for at municipal solid waste landfills in Wisconsin. This reduction in monitoring (the use of inorganics and the reduced number of VOCs when they're required) allowed landfill owners considerable savings while providing equivalent environmental protection. Additionally, the VOC data was used to require responsible parties to define the degree and extent of contamination and remediate groundwater contamination at their landfills. Research on methods of assessing groundwater quality data and data quality control completed in the third VOC study has been helpful to BSHWM staff and consultants in interpreting groundwater quality data from landfills and other facilities. This study also showed the need to require laboratories to report data between the Limit of Detection and the Limit of Quantitation.

Three studies from 1991 to 1994 on the potential groundwater impacts at deer pits, yard waste sites, and construction and demolition landfills were conducted because little or no data existed on the potential impact to groundwater from these sites. Research has provided the information necessary to establish policy regarding monitoring and siting of demolition landfills, deer pits, and yard waste sites in Wisconsin. The study of the groundwater impacts

of deer pits showed that impacts were minimal and helped the BSHWM to decide not to require liners and to loosen some construction and reporting requirements. Similarly, the yard waste site study showed only minor groundwater impacts which led the BSHWM to encourage active management of these sites rather than stiffen regulations. The study of construction and demolition landfills showed some groundwater impacts at large sites but little or no impacts at smaller sites. These findings led to new proposed regulations allowing an intermediate size demolition landfill which would have the economic benefits of a large site without the potential negative impacts of very large sites. Since these studies have been conducted, many states and the EPA have contacted the BSHWM about the information collected.

The last study Jack talked about was a comparison of groundwater sampling methods for collecting metals samples at monitoring wells. The study was in response to EPA's October 1991 ban on field filtering of groundwater samples which became effective in October 1994. The BSHWM opposed this ban because many Wisconsin monitoring wells produce very turbid water which can lead to false positive results for metals if samples are not filtered. Additionally, the new EPA-recommended procedure, low-flow pumping, requires a significant amount of additional equipment. The results of the study showed that the low-flow pumping method was appropriate in many circumstances but could not be used to sample slowly recovering wells. The results showed that turbidity was the best indicator that a well has been sufficiently purged. The results of the investigation are being used to revise groundwater sampling procedures required by the BSHWM. Additionally, the study helped establish Wisconsin as one of two leading states playing a major role in advising EPA on revisions to their groundwater sampling requirements at municipal solid waste landfills.

#### **10. Adjournment & Next Meeting**

The meeting adjourned at 3:10 pm. The next meeting of the Groundwater Coordinating Council will be at noon on August 25 in Room 611B of the GEF II building at 101 S. Webster St. in Madison.

Respectfully submitted,

Jeff Helmuth  
Water Resources Management Specialist  
Department of Natural Resources

## Joint Solicitation of Groundwater and Related Research/Monitoring Proposals

November 1994

The University of Wisconsin System (UWS), Wisconsin Department of Natural Resources (DNR), Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP) and Wisconsin Department of Industry, Labor and Human Relations (DILHR) are participating in a joint solicitation of research/monitoring proposals dealing with groundwater and pesticides. Funding will be available for fiscal year (FY) 1996 beginning July 1, 1995. The reasons for this solicitation to be made jointly are to:

- Facilitate proposal writing.
- Streamline the review process.
- Curtail duplication.
- Improve coordination among agencies and researchers.
- Enhance communication between the agencies and between principal investigators.

Joint-funding of some projects may be appropriate, but it is not the purpose of this solicitation to jointly fund all projects. Each agency has its own designated mission and priorities. Contributors to this solicitation and their roles are:

- UWS through its Water Resources Center (WRC). The WRC, with oversight from the UWS Groundwater Research Advisory Committee, has approximately \$145,000 available in FY 96 to fund new projects. The remainder of the UWS groundwater research funds have been committed to ongoing projects for FY 1996. The funds are restricted for use by faculty within the UWS. Projects of fundamental and applied research will be supported on all matters relating to groundwater including natural science, engineering, social science and law. Projects will be considered for long- and short-term support, but each project will be approved for a MAXIMUM of 2 years during any solicitation cycle.
- The DNR has approximately \$160,000 available in FY 96 to fund new groundwater monitoring projects. About \$190,000 has been allocated for ongoing monitoring projects. Proposals must be for groundwater monitoring or related activities. DNR is also helping DILHR fund projects that focus on the performance of currently-approved onsite wastewater treatment (private sewage) systems. The research will establish and improve management practices which will allow the state to meet the groundwater quality standards enumerated in NR 140, Wisconsin Administrative Code. Although no restrictions are placed on who may apply for these funds, preference will be given to UWS and state agency contractors. Contracts will be approved on an annual basis, and no out-of-state submittals will be accepted.
- The DATCP will administer \$155,000 of research funds for FY 96 as part of this joint solicitation. Investigators should note that the focus of the DATCP program is on pesticide research which includes but is not limited to groundwater issues. Proposals may be submitted by any college or university, research foundation or individual having a demonstrated capacity in pesticide or other applicable research.
- The DILHR will administer \$75,000 for FY 96 to support research on alternatives to current onsite wastewater treatment systems. Some of the funds will be available for new projects.

Please read the solicitation carefully; it contains a description of the priorities for each agency program and other pertinent information. Capital items may not be purchased with these funds, and faculty salaries plus fringe benefits will be limited to a maximum of 10% of an individual grant (for a \$50,000 grant, a maximum of \$5,000 can be allotted to faculty salaries and fringe benefits).

A cover page and proposal format have been agreed upon and they are contained in this package. Although all proposals received will be distributed to each agency, each investigator is asked to identify the agency whose mission and priorities best match the project.

Attached is the description of each agency's guidelines, the outline for a cover page, and a detailed format for the proposal. Proposal narratives should be no longer than 10 double-spaced, single-sided pages. If narratives are longer than 10 pages, the extra material over 10 pages will not be reviewed. If supplemental material is included in the narrative, only 10 pages of narrative and supplemental material combined will be reviewed. The cover page, project summary, resumes, and budget are not part of the proposal narrative.

The deadline for submittal of proposals is January 17, 1995. There will be a minimum of two reviews of each proposal, one of which will be from out-of-state. Funding decisions will be made in April 1995, if possible.

If you have any questions please call the following contacts at the individual agencies.

George Blondin	262-3470	University of Wisconsin-Madison
David Lindorff	266-9265	Wisconsin Department of Natural Resources
Jeffrey Postle	224-4503	Wisconsin Department of Agriculture, Trade and Consumer Protection
Bennette Burks	266-0056	Wisconsin Department of Industry, Labor and Human Relations

Please submit the original and three copies of each separate proposal to:

Jeff Helmuth  
Bureau of Water Resources Management  
Wisconsin Department of Natural Resources  
P.O. Box 7921  
Madison, WI 53707

## PROPOSAL FORMAT (Original and three copies)

Deadline for Submission: January 17, 1995

A. Cover Page--Sample copy is appended.

B. Project Summary (not to exceed 2 double-spaced pages)

1. Specific groundwater or related problem addressed by research/monitoring proposal.
2. What will findings contribute to problem solution?
3. Project objectives.
4. Project approach to achieve objectives.
5. Users of project findings.

C. Proposal Narrative (begin on new page, **not to exceed 10 double-spaced pages**)

1. Objectives.
2. Background information describing prior research/monitoring relevant to objectives; references to ongoing projects and how they relate to proposed investigation; information gaps which will be filled by the proposed project.
3. Project plan outlining experimental design and schedule.
4. Methods detailed enough to convince the reviewer that the investigators are up-to-date on modern techniques; a general statement alluding to techniques is not acceptable.
5. Relevance to groundwater and related problems.

D. Principal Investigators

Include 2-page resume (including recent publications) of each investigator and state the time each will spend on the project. A recent reprint or offprint of a key publication should be submitted when available. If any project personnel will receive training, state its nature.

E. Budget using order shown in sample form

1. Salaries and wages, including percentage of grant to be used for faculty salaries.
2. Fringe benefits, including percentage of grant to be used for faculty salaries.
3. Supplies--list office, laboratory, computer and field supplies separately. Fabrication of equipment should be listed as separate item.
4. Travel to support field operations only. Travel to meetings is excluded because of the limited funding.
5. Publication costs.
6. Total direct costs.



SAMPLE COVER PAGE

Project Title

PRINCIPAL INVESTIGATOR:

Name Title and Affiliation Address Telephone FAX

CO-PRINCIPAL INVESTIGATOR(S):

Name Title and Affiliation Address Telephone FAX

Location of Research

Desired Start-up Date and Duration of Project:

Amounts Requested FIRST YEAR SECOND YEAR TOTAL

Check agency(ies) to which this proposal is targeted:

[If appropriate for more than one agency rank highest (1) to lowest (4)]

UWS ( ) DNR ( ) DATCP ( ) DILHR ( )

Date of Submittal

### SAMPLE BUDGET PAGE

Budget Period from July 1, 1995 to June 30, 1996

(Make a separate page for each year of support)

1. Salaries and Wages    Time, % Cost, \$

Name and title if known

a.

b.

c.

d.

% of grant to be used for faculty salaries =  
(including fringe benefits)

2. Fringe Benefits

% of which salaries

3. Supplies

a. Office

b. Laboratory

c. Field

d. Computer

e. Fabrication of equipment

4. Travel only for support of field operations.

Detail transport, meals, hotels and number of persons involved.

5. Publication Costs.

6. Total Direct Costs

7. On a separate sheet, indicate the level of current or pending support.

See attached example.

## UNIVERSITY OF WISCONSIN SYSTEM (UWS) PROJECTS FUNDED THROUGH THE GROUNDWATER RESEARCH ADVISORY COUNCIL

As part of the joint solicitation for groundwater and related research monitoring proposals, the UWS seeks projects of a fundamental or applied nature on any aspect of groundwater research either in the natural sciences, engineering, social sciences or law.

Application Requirements: Most often the principal investigator will be a faculty member on any campus in the UWS. However, academic staff who have achieved nomination to PI status by endorsement of the relevant academic dean may serve in this capacity. Budgetary

Considerations: About \$145,000 will be available for new grants in FY 96. Projects will not be approved in any one budget cycle for a period of more than 2 years. No capital equipment (more than \$1,000/item) will be purchased. Travel for attendance at scientific meetings will not be accepted. Faculty salaries and fringe benefits to be paid from any project will not exceed 10% of the total individual grant.

Priorities: Presented in no particular order of importance.

- Chemical and biological degradation of pollutants in surface soils, subsoils and groundwater, including identification of degradation products.
- Transport of pollutants in soil and groundwater, including elucidation of soil and hydrologic factors controlling movement, and development of predictive models.
- Impact of waste management practices on groundwater contamination.
- Impact of agricultural management practices on groundwater contamination.
- Characterization of geologic factors affecting groundwater movement.
- Examination of the social and economic impacts of groundwater contamination.
- Evaluation of policy alternatives for controlling groundwater contamination.
- Biological, chemical and physio-chemical technologies for remediation of contaminated soils and groundwater.
  
- Biological effects of pollutants.

Proposal Format: Is fully outlined in the joint solicitation.

Review: Each project will receive at least two reviews one of which will be from out-of-state.

## DEPARTMENT OF AGRICULTURE, TRADE AND CONSUMER PROTECTION (DATCP)

### PESTICIDE RESEARCH PROGRAM

#### RESEARCH GRANT PROGRAM FOR FY 1996 SOLICITATION OF APPLICATIONS

Applications are invited for grant awards focusing on regulatory issues associated with pesticide use and control. This program is administered by the Agricultural Resource Management Division of DATCP. Under this program, the Department may award grants not to exceed three years for research projects on the program priorities outlined below. Proposals may be submitted by any college or university, research foundation or individual having a demonstrated capacity in pesticide or other applicable research.

#### DATCP RESEARCH PRIORITIES FOR FY 1996

- 1) **Evaluation of the Environmental Fate Investigation Strategies and Remediation Alternatives for Contaminated Soil and Water at Pesticide Spill Sites.**

This Project should study the degradation and movement of pesticides at spill sites, develop criteria on the need for and appropriate extent of remedial actions, and evaluate various methods for investigation and remediation of contaminated soil and water.

- 2) **Refinement of Application Methods for Pesticides with High Drift Potential to Reduce Environmental and Public Health Problems.**

This research should focus on how different application methods and environmental conditions affect the potential for drift of pesticides such as metham sodium or elomazone.

- 3) **Evaluation of Factors Influencing the Patterns of Groundwater Contamination by Pesticides and Pesticide Metabolites in Wisconsin.**

This topic involves looking at factors which influence pesticide leaching to determine areas of the state that are susceptible to groundwater contamination by specific pesticides.

- 4) **Use Related Monitoring of Pesticides and Pesticide Metabolites in Groundwater.**

This Project should look at groundwater contamination by field application of pesticides in key environmental settings such as fractured bedrock areas.

- 5) **Identification of the Sources of Pesticide Contamination in Groundwater in Rural Wisconsin.**

Methods should be developed and investigations conducted at contaminated well sites to determine if the contamination is due to field use (nonpoint source) or spills or mishandling (point source) of pesticides.

- 6) **Evaluation of the Economic Feasibility of Various Chemical and Non-Chemical Weed Control Practices.**

This project should develop a methodology for evaluating the economic feasibility of modifying weed control practices and apply it to examples where practices are changed to reduce impacts on groundwater.

#### **7)Pesticide Use Surveys.**

These projects should conduct detailed pesticide use surveys that complement other data gathering efforts, such as ground and surface water monitoring, in order to improve the understanding of pesticide related issues and problems.

#### **8)Use Related Monitoring of Pesticides in Surface Water and the Effect of Management Practices on Contaminant Levels.**

Projects on this topic should determine the impacts of pesticide use practices on surface water quality and evaluate the ability of various management practices, such as stream setbacks, to reduce contamination.

#### **9)Evaluation of the Effect of Pesticide Use on Endangered Species and their Habitat.**

This topic should explore how the use of specific pesticides affects the habitat and survival of endangered species in Wisconsin and how alternative pest control methods could reduce problems.

#### **10)Evaluation of Health Risks from Exposure to Commonly Used Lawn Care Pesticides.**

This project should evaluate the health risks following applications of lawn care pesticides such as pendimethalin, 2,4-D, dicamba, and MCPP.

#### **11)Development of Pest Management Techniques that Lead to Efficient Use of Pesticides and Reduce Impacts on the Environment.**

This project should look at ways of reducing pesticide use through integrated pest management, use of alternative pest control strategies, best management practices, or other techniques that promote efficient pesticide use and minimize environmental problems.

## DEPARTMENT OF INDUSTRY, LABOR AND HUMAN RELATIONS

### RESEARCH OBJECTIVES

The Department of Industry, Labor and Human Relations (DILHR) is currently conducting research focused on alternate onsite sewage system designs, products, and management practices that can be incorporated into the administrative rules regulating onsite sewage systems. These designs, products, or management practices must be:

- Directed towards minimizing nitrate loadings to protect groundwater and surface water quality;
- Result in onsite sewage treatment that is consistent with the provisions of the Groundwater Protection Law, particularly as it relates to the nitrate standard;
- Be affordable by the average owner of an onsite sewage system; and
- Be practical for the climate and soils of Wisconsin.

Application Requirements: Anyone may apply for research funds. Applicants will be required to demonstrate education, training, and experience consistent with research objectives.

Budgetary Constraints: The Department is limited to a budget of \$75,000 per year, and existing projects may receive continued funding for another year. Applicants are encouraged to seek additional funding from the DNR, or other sources, where projects also meet funding priorities of other agencies.

Proposal Format: The proposal format is outlined in the joint solicitation.

Review: Each project will be reviewed individually.

## WISCONSIN DEPARTMENT OF NATURAL RESOURCES

### GROUNDWATER MANAGEMENT PRACTICE MONITORING PROGRAM

Management practice monitoring is defined as groundwater monitoring or support activities associated with groundwater monitoring, such as laboratory technique development or geologic resource description, for establishing or improving management practices necessary to meet the state groundwater quality standards of NR 140, Wis. Adm. Code.

#### Applicant Requirements

Any individual, government body or private concern can submit project proposals; however, preference will be given to University of Wisconsin System and state agency contractors. No submittals will be accepted from out of state.

#### Budget Considerations

Monitoring proposals will be considered for a maximum of two years. Projects costing less than \$25,000 annually will be given greater consideration. Management practice monitoring projects are funded solely by state funds; there are no federal funds involved. Budget items to be identified should include such things as personnel costs, supplies, equipment, necessary travel, and other appropriate items. The management practice monitoring funds cannot support capital equipment or indirect costs.

A number of projects which are being funded in fiscal year (FY) 1995 will continue into FY 1996. As a result, some money will be set aside to fund continuing projects. Approximately \$160,000 will be available to fund new monitoring projects in FY 96.

In preparing the budget be aware of the following contractual requirements.

#### Contractual Requirements

All monitoring wells installed shall meet Department regulations and approved procedures for installation, construction and documentation (Chap. NR 141, Wis. Adm. Code.)

For each new monitoring well, a well construction report shall be submitted on a form (Form 4400-113A) or in a computer format supplied by the Department.

For all groundwater sample points (monitoring wells, piezometers, and private water supplies), an inventory form supplied by the Department shall be completed and submitted.

For any water supply well that is sampled, the contractor shall determine if a well construction report was prepared. A copy of the well construction report, if available, shall be attached to the inventory form.

All groundwater quality monitoring data shall be collected on forms or in a computer format provided by the Department and shall be reported to the Department within two (2) weeks after the data has been received by the contractor. Computerized data shall be verified by the contractor.

All groundwater samples shall be analyzed by a laboratory certified in Wisconsin for that purpose under Chapter NR 149, Wis. Adm. Code.

The contractor shall request labels with Wisconsin Unique Well Numbers from the Department for wells constructed and/or sampled to allow identification of wells. Wells shall be labeled to allow identification.

Abandonment of monitoring wells shall be the responsibility of the contractor. Wells shall be abandoned in accordance with Department regulations (Chap. NR 141, Wis. Adm. Code) and approved procedures upon completion of the project, unless alternative prior arrangements have been made with the Department.

### **Review of Proposals**

All proposals will be reviewed by DNR staff, the Monitoring and Data Management and the Research Subcommittees of the Groundwater Coordinating Council. Projects given high rankings will be those that address identified priority concerns and appear to have a high probability of successfully obtaining their stated goal.

The project must involve either groundwater monitoring or activities conducted to support groundwater monitoring. Support functions can include, among other things, laboratory analysis technique development, well drilling and construction methodology development and definition of geologic and hydrogeologic conditions for groundwater management purposes.

It is also important that the proposal address a priority monitoring topic as listed below. Other considerations include project cost, proposed timeline, whether the proposed project methodology will meet the objectives stated, whether the resources requested are adequate to carry out the project, and whether the project investigators have the abilities to complete the proposed project.

In making final funding decisions, the DNR's Groundwater Management Section will formulate its recommendations based on the input from all project reviewers. The Bureau Director of the DNR's Bureau of Water Resources Management will make the final funding decisions.

### **Priority Monitoring Topics**

For state FY 1996, the following priority topics for groundwater management practice monitoring have been selected based on input from a number of state agency staff and university researchers to identify priorities to meet state needs. This list of priority needs is not in any specific order.

1. Nitrate management Examples: monitoring to determine the percentage of fertilizer (including manure) applied to the land surface which reaches groundwater and the factors that affect the amount of leaching that occurs; monitoring to determine if changes in fertilizer application procedures and/or tillage practices have significant potential for reducing nitrate impacts on groundwater; monitoring to correlate groundwater quality with the extent of land owner implementation of best management practices in environmentally sensitive areas; monitoring to evaluate the impacts of animal waste management practices including barnyards, storage design and operation and manure application on



groundwater quality; and monitoring to distinguish nitrate contamination caused by chemical fertilizer application from nitrate contamination from other waste sources.

2. Pesticide management Examples: monitoring to determine if changes in pesticide application procedures and/or tillage practices have significant potential for reducing pesticide impacts on groundwater, especially projects focusing on atrazine, alachlor (Lasso™) and metolachlor (Dual™) and the potential reduced groundwater impact from pesticide use under low input agricultural practices; monitoring to identify the soil and geologic conditions under which pesticides contamination is likely to occur; evaluation of the extent of groundwater contamination from agricultural and nonagricultural pesticide use and handling in various geologic settings; contamination potential and possible health impacts of pesticide metabolites and alternatives to atrazine; monitoring at pesticide loading facilities to evaluate the effectiveness of the facility to protect the surrounding soils and groundwater from contamination; development of laboratory procedures for analyzing metabolite concentrations in water and soil.
3. Landfill regulation Evaluation of current or innovative landfill design, operation or monitoring criteria in relation to compliance with groundwater quality standards.
4. Groundwater remediation Examples: monitoring of vapor extraction systems to determine their effectiveness in removing volatile organic compounds from various depths and soil types; monitoring various types of bio-remediation methods to determine how effective they are in Wisconsin.
5. On-site wastewater disposal Monitoring to evaluate the extent to which current and alternative on-site wastewater (private sewage) systems comply with state groundwater quality standards. Examples: Identification and quantification of contaminants in groundwater resulting from wastewater disposal through private sewage systems, including commercial and industrial operations; determination of the extent to which current septic system technology prevents wastewater contaminants from complying with groundwater quality standards in various hydrogeologic settings or varying operating conditions; determination of the performance of new or innovative alternatives to current technology, design criteria or management practices with respect to groundwater quality; field monitoring studies to separate the impacts of septic systems from those from other sources, such as current and previous agricultural practices, lawn fertilizer use, road salt use and nearby commercial operations.
6. Urban nonpoint pollution Examples: evaluation of infiltration trenches, infiltration basins leaking sewer lines, and grass swales; determination of the constituents of urban discharge runoff water; monitoring in areas of continuous use of fertilizer and pesticide, such as at golf courses or cemeteries.
7. Wastewater treatment Monitoring of different types of wastewater land application and land spreading practices. This would include the landspreading of waste water byproduct solids, such as sludges and septage, as well as the land application of industrial and municipal wastewaters through dedicated systems.
8. Organic chemicals Evaluation of the extent of groundwater contamination from organic chemicals in various geologic and land use settings.

9. Naturally occurring substances Evaluation of the distribution and seasonal fluctuation of naturally occurring substances such as radionuclides, arsenic, sulfate or saline waters.
10. New technology Development of new laboratory or field technology (or new applications of existing technologies) for determining the characteristics of groundwater and geologic formations for management purposes, including toxicity testing and downhole groundwater monitoring techniques.
11. Data management Development of improved methods for managing groundwater monitoring data. Examples: interpretation techniques for comparing groundwater quality data to groundwater standards; methods to make groundwater quality or contaminant source data more readily available; and spatially relating various chemical and geologic conditions.
12. Resource definition Resource definition studies to better describe the geologic and groundwater properties in the state for management purposes.
13. Wellhead protection Evaluation of techniques used to delineate wellhead protection areas in various geologic settings. Evaluation of methods and planning strategies used to protect groundwater in wellhead protection areas in various geologic settings, especially with respect to the use of pesticides.
14. Vulnerability information verification Field studies to verify resource data used for vulnerability assessments.
15. Evaluation of health effects of groundwater contaminants Investigate health effects of groundwater contaminants, especially nitrate associated health effects. Investigate interactive or synergistic effects of substances which are frequently found together in groundwater.
16. Groundwater - surface water connection Monitoring of surface and groundwater flow to determine hydrologic connections and pathways between them to assess the potential movement and fate of contaminants from one hydrologic regime to another. Example: monitoring of wastewater lagoons located near streams or wetlands. Investigate the occurrence and causes of aquifer drawdowns that affect surface water features such as springs, streams and wetlands.
17. Microbial contamination of groundwater Investigate the incidence, analytical and monitoring techniques and infective dosages of microbial contaminants, including parasites, bacteria and viruses.
18. Land use management Examination of the impact of land use (e. g. urbanization) on groundwater quality and quantity.

**TABLE 3**  
**STATE OF WISCONSIN**  
**GROUNDWATER MONITORING/RESEARCH PROJECTS 1986-1994**

A Simple Stochastic Model Predicting Conservative Mass Transport Through the Unsaturated Zone into Groundwater. J. Hoopes. 1986. DNR. DNR Project #1.

Groundwater Monitoring for Pesticides. J. Postle. 1986-1994. DNR. DNR Project #2.

Fate of Aldicarb Residues in A Groundwater Basin near Plover, Wisconsin. G. Kraft. 1986-87. DNR. DNR Project #3.

Volatile Organic Compounds in Groundwater and Leachate at Wisconsin Landfills. M. Friedman. 1985-87. DNR. DNR Project #4a.

VOC Contamination at Selected Wisconsin Landfills - Sampling Results and Policy Implications. J. Battista. 1988-89. DNR. DNR Project #4b.

Volatile Organic Compounds in Small Community Wastewater Disposal Systems Using Soil Absorption. W. Boyle, W. Sonzogni. 1986. DNR. DNR Project #5.

The Use of Groundwater Models to Predict Groundwater Mounding Beneath Proposed Groundwater Gradient Control Systems for Sanitary Landfill Designs. J. Hoopes. 1986. DNR. DNR Project #6.

Evaluation Techniques for Groundwater Transport Models. J. Hoopes. 1986. DNR. DNR Project #7.

West Bend Road Salt Use and Storage Study. M. Sucht. 1986-91. DNR. DNR Project #9.

Barnyard Management Practices: Effect on Movement of Nitrogen Through Soils and Impact on Groundwater Quality. B. Shaw. 1991-92. DNR. DNR Project #9.

The Prediction of Nitrate Contamination Potential Using Known Hydrogeologic Properties. D. Cherkauer. 1986-87. DNR. DNR Project #10.

Nitrate Contamination in West-Central Wisconsin with Emphasis on Mill Run First Edition Subdivision. J. Tinker. 1987-90. DNR. DNR Project #11.

Investigation of Hydrogeology and Groundwater Geochemistry in the Shallow Fractured Dolomite Aquifer in Door County, Wisconsin. R. Bradbury. 1986-1990. DNR. DNR Project #12.

Lead Migration from Contaminated Sites - Door County, Wisconsin. J. Wiersma, R. Stieglitz. 1987-88. DNR. DNR Project #13.

Graphical and Statistical Methods to Assess the Effect of Landfills on Groundwater Quality. R. Potter. 1986-87. DNR. DNR Project #14a.

Methods for Determining Compliance with Groundwater Quality Regulations at Waste Disposal Facilities. R. Potter. 1988-89. DNR. DNR Project #14b.

Groundwater Quality Monitoring - Long Term Effects of Intensive Farming and Sprinkler Irrigation on Groundwater Quality. P. Kammerer. 1986. DNR. DNR Project #15.

The Effect of Construction, Installation and Development Techniques on the performance of Monitoring Wells in Fine-Grained Glacial Till. D. Cherkauer, C. Palmer. 1986. DNR. DNR Project #16.

Field Investigation of Groundwater Impacts from Absorption Pond Systems Used for Wastewater Disposal. J. Hoopes. 1985-86. DNR. DNR Project #17a.

A Case Study of Nitrogen Transformations at a Rapid Infiltration System Used for the Disposal of Food Processing Wastewater. W. Boyle, J Hoopes. 1986. DNR. DNR Project #17b.

The Occurrence of Volatile Organic Compounds in Wastewater, Sludges and Groundwater at Selected Wastewater Treatment Plants in Wisconsin. C. Hunger. 1985-90. DNR. DNR Project #18.

Fate and Mobility of Radium-226 in Municipal Wastewater Sludge Following Agricultural Landspreading. T. Portle. 1986. DNR. DNR Project #19.

Filtration Preservation Study of Groundwater Samples. D. Sauer. 1984. DNR. DNR Project #21a.

Groundwater Survey of Bacterial Contamination Near Rapid Infiltration Wastewater Treatment System. C. Norenberg, J. Standridge. 1987. DNR. DNR Project #21b.

Hydrogeology of the Wisconsin River Valley in Marathon County, Wisconsin. R. Bradbury. 1986. DNR. DNR Project #22.

Treatment of Cheese Processing Wastewater by Ridge and Furrow Disposal - Nitrogen Transformations. W. Boyle 1986. DNR. DNR Project #23.

Environmental Investigation of the City of Two Rivers Landfills, Manitowoc County, Wisconsin. T. Van Biersel. 1986-87. DNR. DNR Project #24.

Hydrogeologic Investigation and Groundwater Quality Assessment (Havenswood Landfill). P. Singh. 1987. DNR. DNR Project #28.

Groundwater Quality and Laundromat Wastewater: Summit Lake, Wisconsin. J. Saltz. 1986-1988. DNR. DNR Project #29.

Flambrau Paper Sulfite Lagoon Site Contamination Study. W. Lantz 1987. DNR. Project #30.

Monitoring of Volatile Organic Compounds in Tomah, Wisconsin. C. Krohn. 1986, 1989. DNR. Project #31a.

Hydrogeological Investigation of VOC Contaminated Private Wells Near Hudson, Wisconsin. J. Anklam. 1986. DNR. DNR Project #31b.

Sealing Characteristics of Sodium Bentonite Slurries for Water Wells. T. Edil. 1988. DNR. DNR Project #34.

Barron County Nitrate Study. D. Hanson. 1986-87. DNR. DNR Project #37.

Mutagenic Effects of Selected Toxicants Found in Wisconsin's Groundwater. L. Meisner, D. Belluck. 1988-89. DNR. DNR Project #38.

Downward Movement of Water Below Barnyard Grass Filter Strips - Case Studies. G. Bubbenzer, J. Converse. 1987-1989. DNR. DNR Project #39.

1987 Volatile Organic Compound Testing Project in Rock County, Wisconsin. D. Holman. 1987. DNR. DNR Project #40.

Volatile Organic Compound Contamination of Private Water Supplies Adjacent to Abandoned Landfills in Marathon County. T. Wittkopf. 1986-1989. DNR. DNR Project #41.

Investigation of Large Scale Subsurface Soil Absorption Systems. D. Pzerenboom. 1987. DNR. DNR Project #42.

Characterization of Groundwater Impacts at an Above Ground Petroleum Storage Terminal. G. Becker, R. Ham. 1987. DNR. DNR Project #43.

Lead Contamination Study of Door County. R. Stoll. 1988. DNR. DNR Project #44.

Freedman Creek Hydrogeologic Baseline Report. A. Wilson 1988-89. DNR. DNR Project #45.

Analytical Determination of Atrazine, Alachlor and Their Selected Degradation Products in Contaminated Groundwater: Implication for Wisconsin Groundwater Standards. W. Sonzogni. 1988-89. DNR. DNR Project #47.

Plover Area Nitrate Study. F. Bailey. 1987-88. DNR. DNR Project #48.

Assessment of Geologic Controls on Groundwater Flow and Distribution in Precambrian Bedrock, Central Wisconsin, Using Remote Sensing and Geophysical Analysis. B. Brown, D. Davidson Jr. 1988. DNR. DNR Project #49.

A Ground Penetrating Radar Study of Water Table Elevation in a Portion of Wisconsin's Central Sand Plain. M. Anderson, C. Bentley. 1988. DNR. DNR Project #50.

Mineralogical and Geophysical Monitoring Naturally Occurring Radioactive Elements in Selected Wisconsin Aquifers. G. Morsky, R. Taylor. 1988. DNR. DNR Project #51.

Degradation of Atrazine, Alachlor, Metolachlor in Soils and Aquifer Materials. G. Chesters. 1988-1990. DNR. DNR Project #52.

Evaluation of the Effect of Stormwater Disposal on Groundwater. G. Nienke, B. Shaw. 1988-89. DNR. DNR Project #53.

Radionuclides in Drinking Water of Northcentral Wisconsin. B. Dobbins, C. Fitzgerald. 1988-89. DNR. DNR Project #54.

Pesticide Migration Study. Shaw. 1989-90. DNR. DNR Project #55.

Research and Data Analysis of Groundwater Contamination from Municipal Rapid Infiltration Land Disposal Systems. W. Boyle, J. Hoopes, R. Potter. 1987-88. DNR. DNR Project #56.

Digital Simulation of Solute Transport to Green Bay and Lake Michigan by Groundwater from Door County, Wisconsin. D. Cherkauer. 1988-91. DNR. DNR Project #57.

Grade A Dairy Farm Water Well Quality Survey. G. LeMasters, D. Doyle. 1989. DNR. DNR Project #58.

Demo of Low Input Strategies for Potato/Vegetable Production in Irrigated Sands. Shaw, Curwen, Kraft, Osborne. 1989-90. DNR. DNR Project #59.

Groundwater Quality Investigation of Selected Townships in Jefferson County, Wisconsin. F. Madison. 1989. DNR. DNR Project #60.

Effects of Volatile Organic Compounds on Clay Landfill Liner Performance. Edil, Berthouex, Park, Sandstrom. 1989. DNR. DNR Project #61.

Effect of Soil Type, Selected BMPs, and Tillage on Atrazine and Alachlor Movement Through the Unsaturated Zone. Lowery, Meszkeny. 1991. DATCP and DNR. DNR Project #62.

Designs for Wellhead Protection in Central Wisconsin. Osborne, Sorenson, Knaak, Meehnick, Travis. 1989. DNR. DNR Project #63.

Atrazine Contamination of Groundwater in Dane County, Wisconsin. Bradbury, McGrath. 1990-91 DNR., DATCP DNR Project #64.

Sources and Extent of Atrazine Contamination of Groundwater at a Grade A Dairy Farm in Dane County, Wisconsin. Chesters, Levy. 1990-91. DATCP, UWS, and DNR. DNR Project #65.

Effect of Soil Type on Atrazine and Alachlor Movement Through Unsaturated Zone. T. Daniel. 1989. DATCP, DNR. DNR Project #66.

Subdivision Impacts on Groundwater Quality. Shaw, Ameson, VanRyswyk. 1989. DNR. DNR Project #67

Incorporation of County Groundwater Inventory Data into the DNR Groundwater Information Network (GIN). M. Bohn. 1990. DNR. DNR Project #68.

DNR and DATCP Rural Well Survey. LeMasters. 1990. DNR, DATCP. DNR Project #69.

Follow Up to the Grade A Dairy Farm Well Water Quality Survey. Cowell, LeMasters. 1990. DATCP, DNR. DNR Project #70.

Optimum Manure Application Rate - Corn Fertility Management and Nitrate Leaching to Groundwater in Sandy Soils. Shaw. 1989-90. DNR. DNR Project #71.

Report on Bacteriological Water Quality Monitoring of Door County Variance and Special Casing Approval Wells. Hutchinson. 1990-91. DNR. DNR Project # 72.

Volatile Organic Chemical Attenuation in Unsaturated Soil Above and Below an Onsite Wastewater Infiltration System. Tyler, Peterson, Sauer. 1990-91. DNR, UWS. DNR Project #73.

Variation in Hydraulic Conductivity in Sandy Glacial Till: Site Variation Versus Methodology. Mickelson, Bradbury, Rayne. 1990-92. DNR, UWS. DNR Project #74.

A Field Evaluation of Drainage Ditches as Barriers to Contaminant Migration. Bahr, Chambers. 1990-91 DNR. DNR Project #75.

Nitrogen Isotope Monitoring at Unsewered Subdivisions. Tinker. 1990. DNR. DNR Project #76.

Analytical Determination of Pesticide Metabolites and Carrier Chemicals in Wisconsin Wells. Sonzogni, Eldan, Lawrence. 1990. DNR. DNR Project #77.

Integrated Decision Support for Wellhead Protection. Adams, Bengsen. 1991. UWS.

Nitrate Movement Through the Unsaturated Zone of a Sandy Soil in the Lower Wisconsin River Valley. Lowery, Russow. 1991-93. UWS.

In-situ Removal of Fe, Mn, and Ra from Groundwater. Christensen, Cherkauer. 1991. UWS.

Effect of Complex Mixtures of Leachate on the Transport of Pollutants in Groundwater. Grundl, Cherkauer. 1991-92. UWS.

Adsorptive Behavior of Atrazine and Alachlor in Organic-Poor Sediments. Grundl. 1991. UWS.

The Economic Effects of Groundwater Contamination on Real Estate. Page. 1991. UWS.

Near-Source Transport of Contaminants in Heterogeneous Media. Hoopes. 1991-92. UWS.

Chemical Transport Across a Sediment-Water Interface. Green. 1991-92. UWS.

Role of Mobile Colloids in the Transport of Chemical Contaminants in Groundwaters. Armstrong, Shafer. 1991-93. UWS.

Prediction of Organic Chemical Leachate Concentrations from Soil Samples. Park. 1991. UWS.

Using Ground Penetrating Radar to Predict Preferential Solute Movement and Improve Contaminant Monitoring in Sandy Soils. Kung, Madison. 1991. UWS.

A Tracer Technique for Measuring Regional Groundwater Velocities from a Single Borehole. Monkmeyer. 1991. UWS.

Tracking Contaminant Pathways in Groundwater Using a Geologically Based Computer Code for Outwash. Mickelson, Anderson. 1991-92. UWS.

Bioremediation of Herbicide-Contaminated Soil and Water. Harris, Armstrong. 1991. UWS.

Renovation of Pesticide Contaminated Rinse Waters. Chesters, Harkin. 1991. UWS.

Contamination Attenuation Indices for Sandy Soils: Tools for Information Transfer. McSwiggan, Madison. 1991. UWS.

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## Groundwater Education Activities of the Department of Public Instruction

The Department of Public Instruction (DPI), though not a member agency of the GCC does promote and support educational activity related to surface and groundwater quality. DPI is represented on the GCC Education Subcommittee. In FY 95 DPI staff were involved in the following activities:

Groundwater Resource/Curriculum Unit Dissemination - DPI Agricultural Education Staff disseminated Groundwater Education Units to all new instructors. This curriculum resource unit was developed as a nationwide project by the National Council on Agricultural Education. The materials were initially developed, disseminated and put into service in 1991 and have been annually disseminated to new agricultural education instructors and programs since then.

Project Green Stripe - The summer of 1994 was the second year of a pilot project sponsored by Monsanto Agricultural, which encouraged youth to learn about buffer strips along streams and lakes and how run-off from farm fields can adversely impact surface and groundwater. Youth were encouraged to promote "Green Stripes" or buffer strips planted and maintained in their school districts. A total of 14 school districts piloted the project which has been expanded to other states.

Sustainability Workshops - DPI Agricultural Education staff developed materials for and delivered two sets of 10 workshops (fall and spring) for agricultural education instructors and all other interested educators, on sustainable agricultural methods. These workshops emphasized environmental stewardship and impacts on groundwater, surface water, soils, wildlife and forest resources.

Professional Development Programs - Working with the Wisconsin Water Educators, the DPI agricultural education staff offered a workshop on groundwater education and use of groundwater models. The workshop was held at Stevens Point High school in January and featured staff of the Central Wisconsin Groundwater Center. Further, working with staff from the DNR, several workshops were offered on Water Quality, Project Learning Tree, and Project Wild (including WET), during the summer agricultural education conference held in June, 1995 in Madison.